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Devoted to Commercial and Naval Motor Craft

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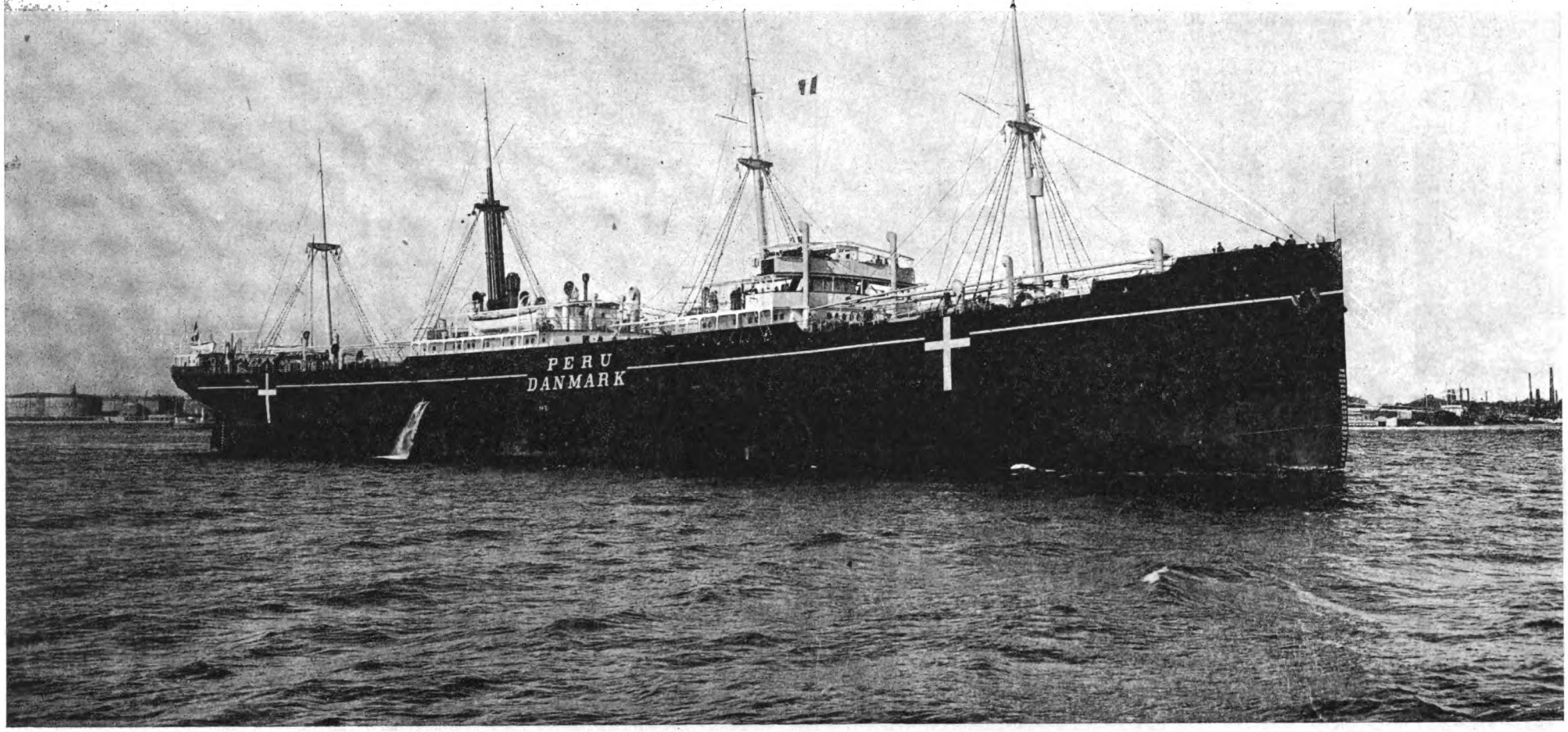

NOTEWORTHY ECONOMICAL MERCHANT SHIPS—No. 31

M. S. "PERU," a fine example of a European cargo motorship of which the United States today should possess hundreds, but unfortunately not a single one is yet in service. She has a displacement of 13,400 tons and a net cargo capacity of over 10,000 tons, in addition to 1,200 tons of bunker-oil, and has excellent accommodation for a limited number of passengers. An oil-fired or coal-burning steamship of the same displacement and same dimensions could carry not more than 9,000 tons on a Trans-Pacific return voyage; so, ton for ton of steel used in her construction per ton of net-cargo lifted, the motorship is a cheaper vessel to build, although her actual first cost is higher. The "Peru" is owned by the East Asiatic Co. of Copenhagen, and two Burmeister & Wain Diesel engines aggregating 3,150 I.H.P. propel her at an average speed of 11 knots at 125 R.P.M., with a fuel consumption of seventy barrels per 24-hr. day. A sister motorship—the "Chile"—recently brought 11,500 tons of sugar (and 400 tons of fuel) from San Francisco to New York, and 160 tons of this fuel were unconsumed on the trip. The dimensions of the "Peru" are: Length, 425½ ft.; breadth, 55 ft.; depth of hold, 38½ ft.; maximum draught, 28½ ft.; draught (normal) with 9,400 tons of cargo, 26½ ft.; draught. With a little over 11,000 tons cargo and 400 tons fuel, the draught is 28 ft. 4 ins.

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MOTORSHIP

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WILSON BUILDING
NEW YORK, N. Y.

71 COLUMBIA STREET
SEATTLE, WASH.

PUBLISHED MONTHLY IN THE INTERESTS OF COMMERCIAL AND NAVAL MOTOR VESSELS
AND FOR RECORDING PROGRESS OF THE MARINE
INTERNAL-COMBUSTION-ENGINE

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The oil-engined motorship has arrived! It is such a pronounced economy that it was bound to come. Nothing could stop it! And all obstacles have been removed as fast as they arose. The law of progress has seen to that. Very strong prejudices stood in the way of steam. But, one after another they were swept aside and steam reigned triumphant for a century. Steam now has had its day! Its zenith has passed, and gradually but surely it is being superseded by the economical internal-combustion power. Steamships are becoming decadent. America, the most important oil-producing country, is to be the greatest motorship-owning nation. Let us all co-operate and assist to make that day soon.

July, 1919 Vol. 4 No. 7

EDITORIAL

THE AMERICAN SHIPBUILDING INDUSTRY AND THE DIESEL ENGINE

WE WISH we could say otherwise, but American ship-owning companies have done extremely little to encourage or develop the heavy-oil internal-combustion engine for merchant-ship propulsion. On the other hand, the initiative has been taken by many domestic shipbuilding concerns, and it will be due to them—not to the owners—also it will be to their credit that in a few years the United States will be the greatest motorship building and owning country in the world.

These shipbuilding firms deserve double acknowledgment because in one sense there is no incentive for them to bother with the trouble of learning how to design and build Diesel engines, as for the time being they can save money by continuing with the manufacture of steam engines and boilers. Whereas, the construction of oil-motors means months of study, investigation, and entirely changing their workshop facilities, aside from the great expense of buying experience, and perhaps a risk of their first engine not being a complete success at the start. It is the shipowner who will effect the greatest benefits from the adoption of motorships because of the enormous economy of operation and greater cargo-carrying capacities thereby derived. Why many American shipbuilders have gone to great expenses in connection with the Diesel engine is, because they realize that unless we do build motorships, the American mercantile marine will quickly drop back into the decadent position existing five years ago, and then there will be hardly any new ships for them to build.

Unfortunately, with a few exceptions, there seems to be an almost complete absence of similar foresight among the majority of shipowning interests of this nation. Huge profits have recently been made and large excess-profit taxes paid; but, none of these shipowners have turned over reasonable amounts of money to ship and engine builders for the purpose of experimenting and developing on their behalf. We speak plainly because the time has come when our words must no longer be minced. Incidentally, confirmation of our remarks can be obtained by glancing through our own columns and seeing who it is that bears the main burden of publishing this journal and thus enabling "Motorship" to continue with its good work on the behalf of the nation's merchant marine. It is **not the shipowning** interests, except for one or two good friends, who have recognized in a material manner that our efforts deserve support, and that later on they themselves will reap a thousand-fold benefit.

A recent instance of the splendid manner in which shipbuilding interests are supporting the oil-engine industry, is to be found in the orders placed by the Submarine Boat Corporation for two large Diesel engines—one of 3,500 I.H.P. with the James Craig Engine and Machine Works for a single-screw cargo ship, and one of about 2,500 I.H.P. with the New London Ship & Engine Co., also for a single-screw freighter. So far as we are aware, this shipbuilding company has shouldered all the attached expense and responsibility without any financial assistance from shipowners. Yet, the maximum benefit from this will accrue to the shipowners who ultlimately get the ships after the Diesel engines are developed perfected. Thus the shipbuilder develops for the shipowner's benefit.

A similar case may be quoted. No less than $350,000.00 has been appropriated by the Newport News Shipbuilding & Dry Dock Co. for Diesel engine development work, and we understand that this will be spent before shipowners will be asked to accept any responsibility in the way of ordering motorships. The same applies to the New York Shipbuilding Corporation. Both would have done this before had they not been prevented by urgent naval shipbuilding. They already have spent much of this sum purchasing European experiences.

Then again the Bethlehem Shipbuilding Company have designed and constructed at their own expense a marine two-cycle type Diesel engine of about 2,500 b.h.p., which for some time has been running tests. Also, the Manitowoc Shipbuilding Company has gone to the cost of purchasing a European license and building some Diesel engines. Cramps also have bought a foreign license at heavy expense.

In view of what has been done, we believe we are justified in calling upon American shipowners and shipowning companies to extend a hand to the heavy-oil engine-builders, and to "Motorship," and do everything within reason to assist motorship development and construction. It is shipowners who will benefit the most!

We will be glad to give space in our columns to the views of shipowners on the foregoing questions. Perhaps it is that up to now they have not realized that their co-operation and assistance is really necessary and must be forthcoming if America is to have a successful merchant marine; for, as is now known, the U. S.

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Shipping Board has "fallen down" rather badly so far as its opportunities to "make good" with motorships are concerned and have cancelled Diesel engine orders placed by the Emergency Fleet Corporation. In order for business to continue properously, America must remain the financial center of the world. To be permanently the financial center, we must have a successful mercantile marine or we at once become dependent upon other countries, and without motorships a successful merchant fleet is practically impossible, no matter how we change our shipping laws. In fairness to the Shipping Board let us say that recently they have been handicapped by lack of funds.

FAR-SIGHTED VIEW OF AN AMERICAN SHIPOWNER

WE have yet to see the American shipowner who has not become a strong advocate of oil-engined ships after having visited motorships and after a deep investigation of the motorshipping question. But it is not often that a steamship owner is far-sighted enough, or has sufficient courage, to publicly acclaim the importance of the motorship to the United States as has been done by Mr. A. C. Worthington, Vice-President of the Maritime Navigation Co. of San Francisco. Mr. Worthington, in a communication to a contemporary, says, among other statements:

> "Mr. Hurley has announced his intention of selling the Shipping Board ships to the highest bidders. . . . It may be imagination on my part, but I am firmly of the opinion that many persons who buy these ships will have purchased something which before long will have to be junked. Why? Because they have secured a steamer and not a motorship!
>
> "It is high time that the men who control the shipping of America paused and demanded that we take an inventory of what we have. Steamships are being launched each day. Scotch boilers, triple-expansion engines and turbines are being assembled to go into the hulls, and when all is said and done we will have a lot of bargain-counter ships in the end. There is not a right-thinking operator of ships today who does not know that the days of the steamship are numbered. Then why should we persist in going ahead and permitting the government to construct more?
>
> "Suppose you are equipped with a fine fleet of steamers. What chance will you have against the concern possessing a fleet of motorships?
>
> "I do not wish to be an alarmist. I am an optimist by nature and prefer to smile and be happy, but for the life of me I fail to get any comfort in contemplating what will happen to our merchant marine if we center our efforts in the work of building steamships. They will be about as useful for the purpose of winning out as carriers on the seas in the not distant future as the old 'Constitution' would be if revived and sent forth to battle against one of the modern battleships of the first class.
>
> "Let us demand of Mr. Hurley and the Shipping Board that we plan and build ships of a type that will survive the great impending battle of commerce overseas. Let us demand that the best American minds be put to work to evolve a type of motorship that will be just a bit better than anything being built by any other country.
>
> "We must shift to the motorship definitely in the future when competition compels it. Why not make the change now, when we will maintain an advantage and not be forced to make a fight after we have lost all advantage? The entire matter must be solved by the men who operate the ships."

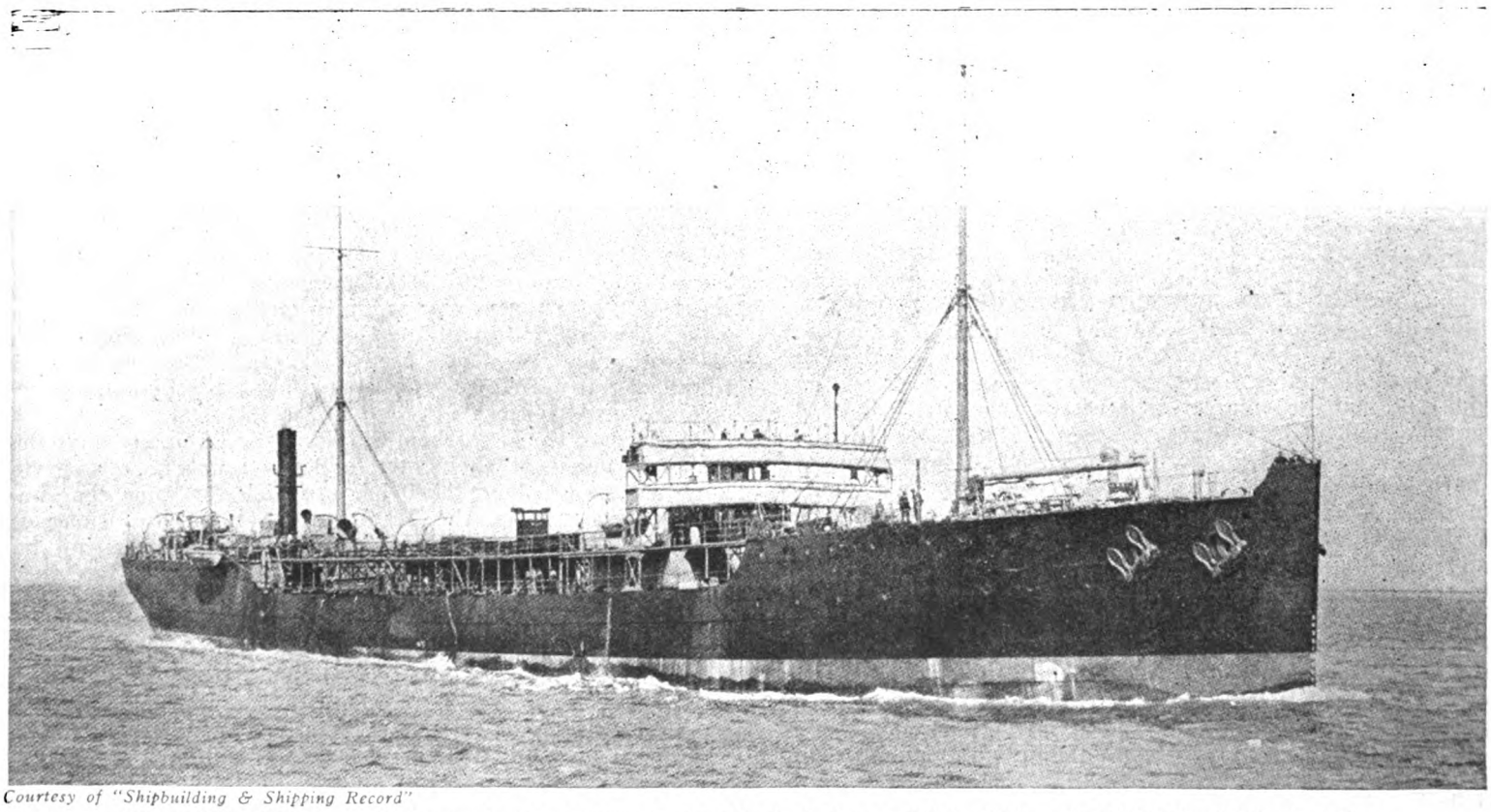
All serious-thinking business men will not attempt to evade discussion of the issue brought forward by Mr. Worthington, but will treat his contentions in the earnest manner that they deserve. Not only are billions of dollars worth of ships at stake, but the entire industry of the country rests with the success of America's merchant marine. Surely we have not forgotten the semi-stagnant condition of business during 1913 and 1914. Without a successful merchant marine those conditions of trade and commerce are bound to return in a very few years; and, if we persist in building steamships, we shall have to bear the additional burden of heavy taxation due to operating hundreds of uneconomical vessels. Our shipping officials can "line our harbors with flowers and promises"; but such will not alter the undisputable fact that even with changes in our shipping laws it will be, and is, impossible to operate American steamships against foreign motorships. We would like to see Mr. Worthington's company demonstrate his views by ordering some motorships and their machinery. Words are pleasant, but actions speak far louder.

WE MOVE INTO NEW OFFICES

OWING to the remarkable growth of "Motorship" and its sister publications, "Pacific Motorboat" and "Pacific Fisherman," it has been necessary to move into larger quarters. The head-office of "Motorship" by the beginning of this month (July) will be in the Wilson Building, corner Broadway and 33rd Street, New York City, while our Pacific Coast office and the office of our sister journals have been moved to 71 Columbia Street, Seattle, Wash.

OUR JUNE SUPPLEMENT

APOLOGIES are due our readers for the late delivery of the special Schneider War and Peace Commemorative Supplement given with our June issue, which was caused by unforeseen delays in connection with the printing of this beautiful work of art, and the delicate processes in connection thereof. For instance, on the medals under the portraits of Mons. E. Schneider and his sons, each of which covered less than a quarter of a square inch, there were no fewer than 6 colors including bronze and silver and each color required a separate printing and drying. Undoubtedly no technical publication has ever before issued such a magnificent and finely printed supplement.



Courtesy of "Shipbuilding & Shipping Record"

The British 14,750 tons displacement motor-tanker "Santa Margherita" propelled by Vickers "solid-injection" Diesel engines.

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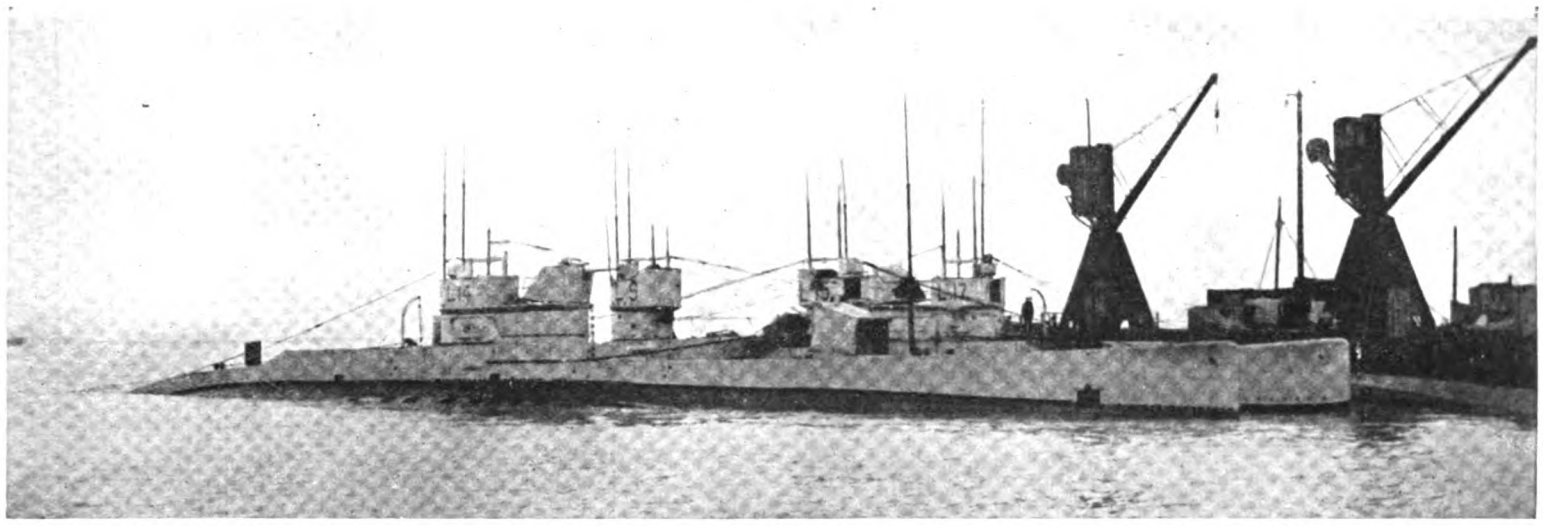


Photo., Underwood & Underwood ©
Four British L-class Diesel driven submarines. They are 238½ feet long and of 2,600 b.h.p.

Motorship "Trolltind" En Route for Denmark

A New American Wooden Motorship

THE wooden motorship "Trolltind," recently built on Puget Sound, arrived in San Francisco Bay on May 22nd, and after spending two days in the stream off San Francisco, went to Port Costa to take on a cargo of barley for Denmark. The "Trolltind" made an excellent trip down the Coast from Seattle. No effort was made to push her, but with her engines turning 190 revolutions per minute she averaged 8 1-4 knots.

She is equipped with twin eight-cylinder four cycle type Winton Diesel engines of 500 h.p. each. On her first trip to this port her fuel-consumption figured at 0.46 lb. per b.h.p. hour, using a 24 gravity oil. Her consumption of lubricating oil was 10 gallons daily, but this will be materially cut down now that all parts are thoroughly oiled. The vessel has a storage capacity of 1,550 barrels of fuel-oil and 40 barrels of lubricant, enough to more than take her around the world. In connection with the main engine there is an Atlas engine driven two-stage compressor also of Winton design, turning at 250 revolutions, and the same engine also drives a 6in. x 9in. Triplex pump for universal service. The lubricating oil flows continually from an oil-filter, circulating first through the filter, then through the engine and back again to the filter. From 10 to 15 pounds pressure is carried on the lubricating system.

The auxiliary equipment consists of a Fairbanks-Morse oil-engined generating plant for lighting, steering, electric-fans, whistle, compressor and Universal Triplex pump for general service. A Westinghouse 10 k-w set for emergency purposes is driven by the flywheel of the main engine. A Fairbanks-Morse circulating pump is used for cooling the main engine when the engine is maneuvering.

Other equipment consists of an oil-burning donkey-engine for steam winches, condensor and hot well, and for the hot-water heating plant for the officers quarters. A complete machine-shop occupies a portion of the engine-room, consisting of a lathe, drill-press, emory wheel and a good stock of tools.

The "Trolltind" measures 260 feet over all. She has a beam of 46 feet and a depth of 26 feet 5 inches. Her deadweight capacity is 3,350 tons dwc. Her crew outside the engine-room consists of about the same number of men that a steamer of like tonnage would carry, consisting of the captain, three mates, and twelve members of the crew including the cook and his staff. In the engine-room there is a chief-engineer, three assistants, three oilers and a dayman. A steamer of like capacity would require in addition at least 6 firemen and coal passers, at a cost of about $675.00 a month more than the charges against the motorship. Her net carrying capacity is at least 400 tons greater than a steamer of the same size as she need no tanks for boiler water and has smaller bunkers. These are the factors in favor of the motorship compared with the steamship.

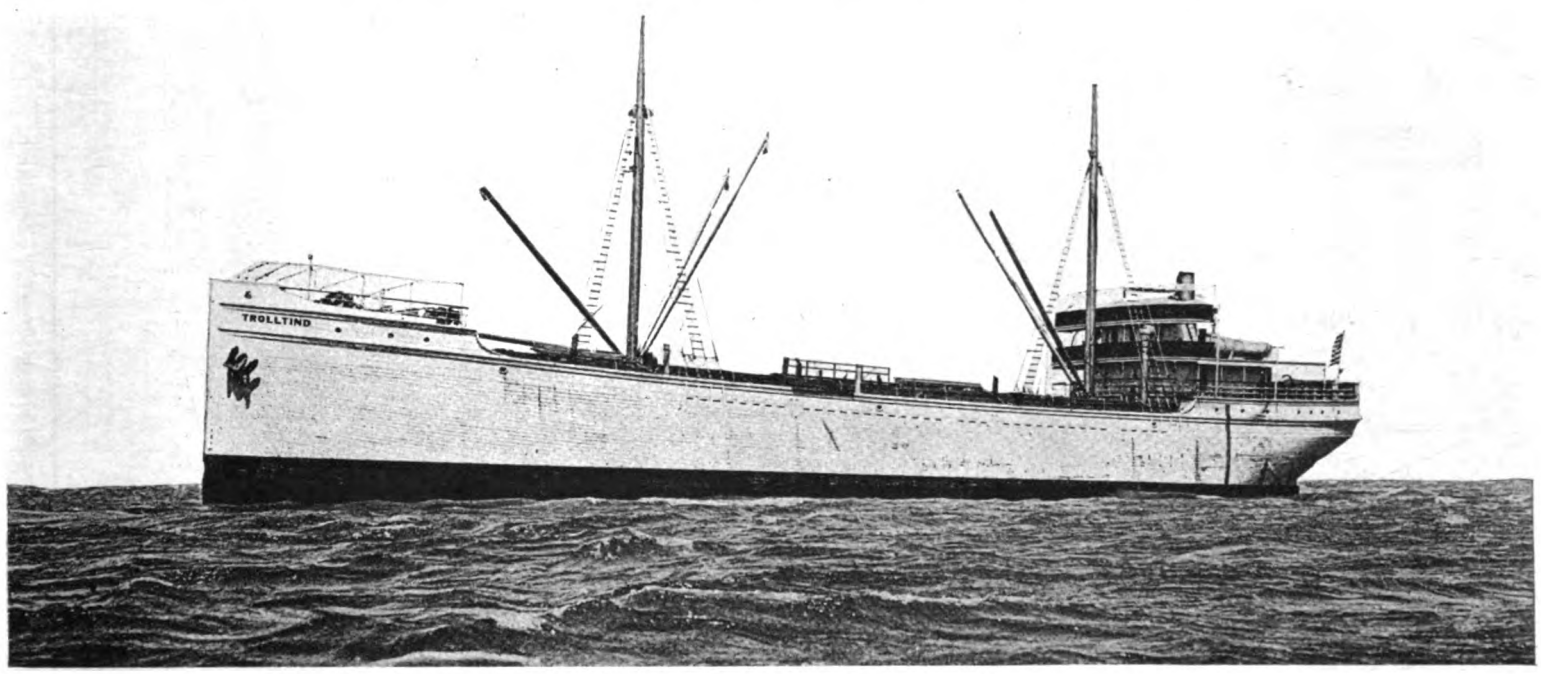
In addition might be added the greater economy in consumption of fuel per mile traveled, and the fact that when lying at anchor or at a wharf it is not necessary to keep up steam. While exact figures are not obtainable on this feature it is stated that operating expenses, that is the machinery needed to be kept running or in shape for immediate use, is fully twice as much in a steamship as in a motorship when each ship is at anchor.

C. I. Jackson, chief-engineer of the "Trolltind," is the man who took over the first motor vessel built in the northwest for the French Government. On his arrival in France the French Government offered him inducements to join their navy to have charge, as chief-engineer, of the French fleet of motorships, and for eighteen months he served in the navy of that country. Jackson was only recently discharged from the French Navy and the "Trolltind" is his first charge since returning to this country.

SOLID INJECTION AND SMOKE

With reference to the note on "Solid-Injection and Smoke" made by a British submarine officer and published in the May issue of "Motorship," a submarine artificer says that it is absurd to say that solid-injection oil-engines smoke no matter how carefully they may be adjusted. He maintains that "given a certain type of spray nozzle and a reasonable amount of attention to settings and injection timing, these engines will run with an almost colourless exhaust. This, after a great deal of practical experience, during which he has been repaid for going over the timing and paying attention to spray valves, with the clearness of the exhaust gases, and this with two 12-cylinder engines." He also says:—

"The alleged deficiences of solid-injection are often used as an excuse for excessive smoking by men who cannot or will not pay this very necessary attention. There are also other factors which contribute to smoke output such as over-lubrication of the cylinder walls and a consequent burning of this oil after leaking past the rings, which produces a whitish smoke; and, low-compression temperatures due to leaky valves, piston-rings, or too much top clearance above piston. Then again, leaky spray-valves or 'sticky' spray-valves caused by over tightening of the glands, thereby making the needle sluggish in its closing—this latter effect being more apparent at high speeds."



The American-built Diesel-engined motorship "Trolltind"

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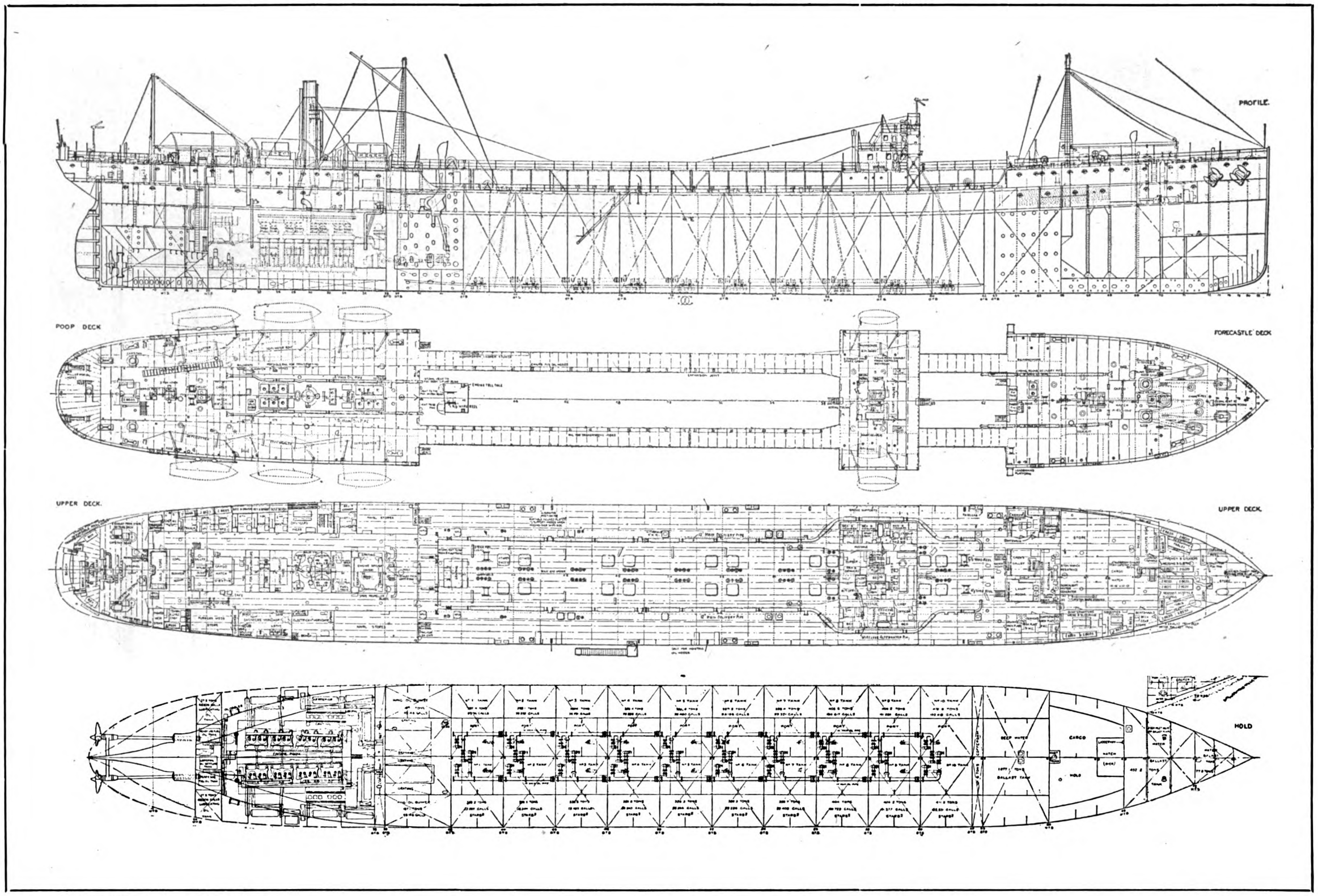

Courtesy of "Shipbuilding & Shipping Record"

General arrangement drawings of the Vickers 14,750 tons displacement motor tanker "Santa Margherita." She is the first large bulk-oil carrier to have Diesel-electric auxiliaries throughout. Her dimensions are:— Length 440 ft.; Breadth 54 ft. 3 in. Fitted with two Vickers solid-injection Diesel engines aggregating 3,330 I.H.P. (2,500 b.h.p.) and auxiliaries of 1,500 I.H.P. (1,150 b.h.p.). She has been in service about two years

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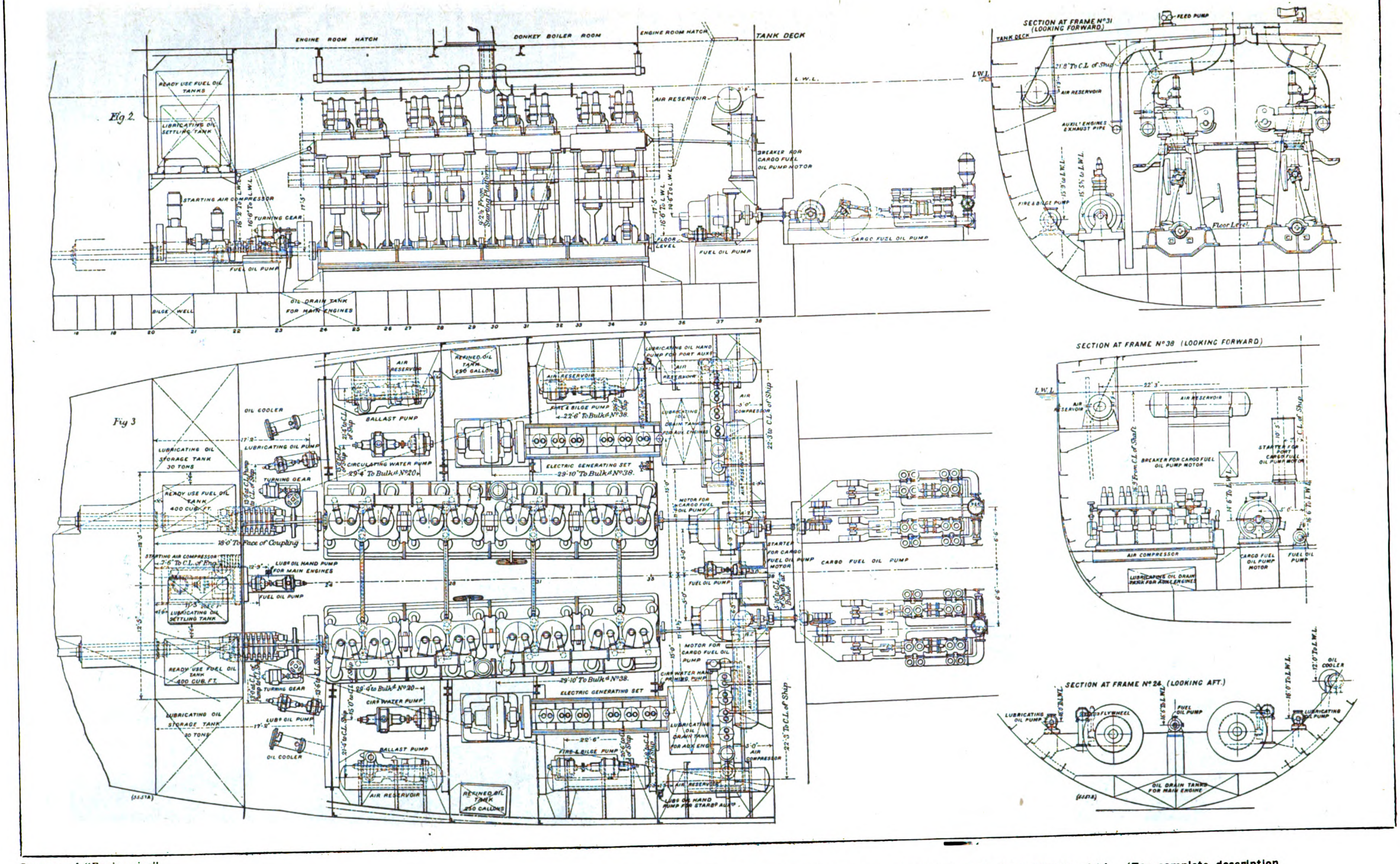

Courtesy of "Engineering"

General arrangement of the engine-room of the British motor tanker and freighter "Santa Margherita" 11,000 tons d.w.c., built and engined by Vickers, Ltd. (For complete description see page 14, of the Sept. 1918 issue of "Motorship.") The Diesel-electric auxiliaries are very complete totalling 1,150 b.h.p. The two main Diesel engines together develop about 3,250 i.h.p. She carries 2,000 tons of general cargo, 8,000 tons of oil-cargo, and 900 tons of bunker oil. Her sea-speed is 11 knots loaded. Her fuel-consumption is 0.28 lbs. per i.h.p., or less than one-third of the most economical oil-fired geared turbine ship yet built. She is of particular interest as one of the British associates of the Standard Oil Co. is having a motor tanker built by Vickers, Ltd., also with solid-injection engines.

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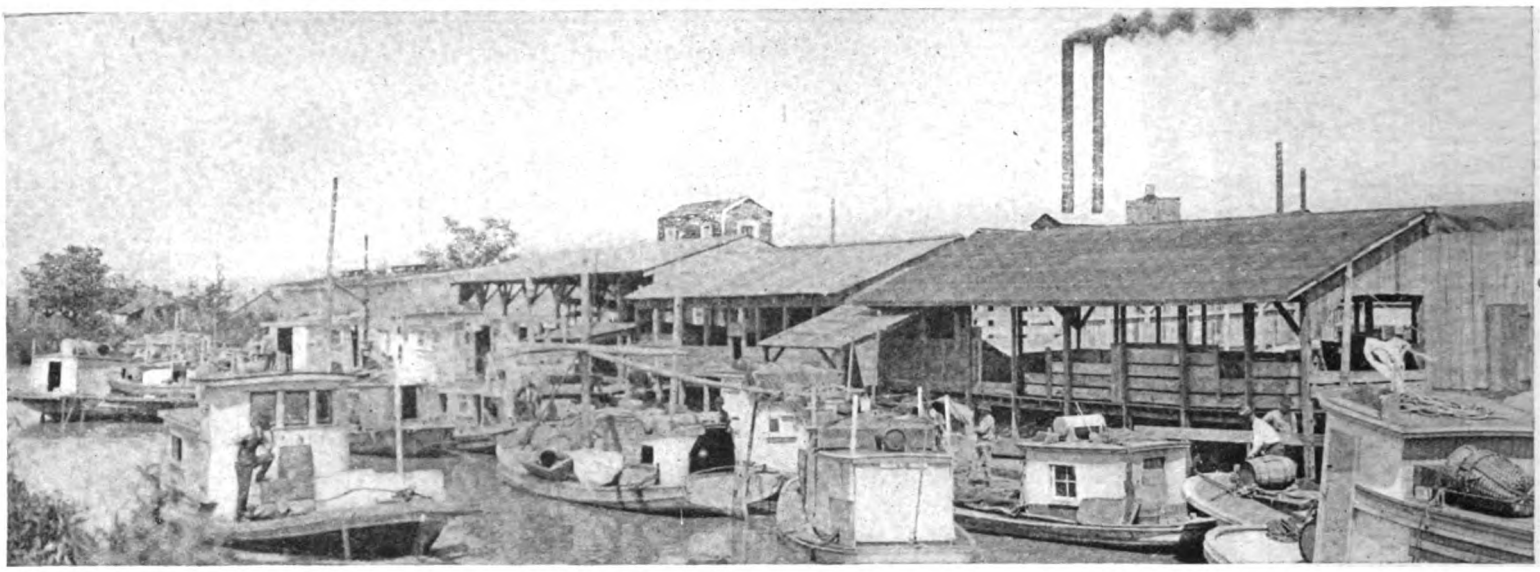


Motor work-fleet taking on merchandise for transportation to the settlements and plantations on the inland waterways of Louisiana

Minor Motorships That Pay

Fleet of Power Workboats Which Handle the Internal Traffic of Half a State, and Virtually Feed a Large City

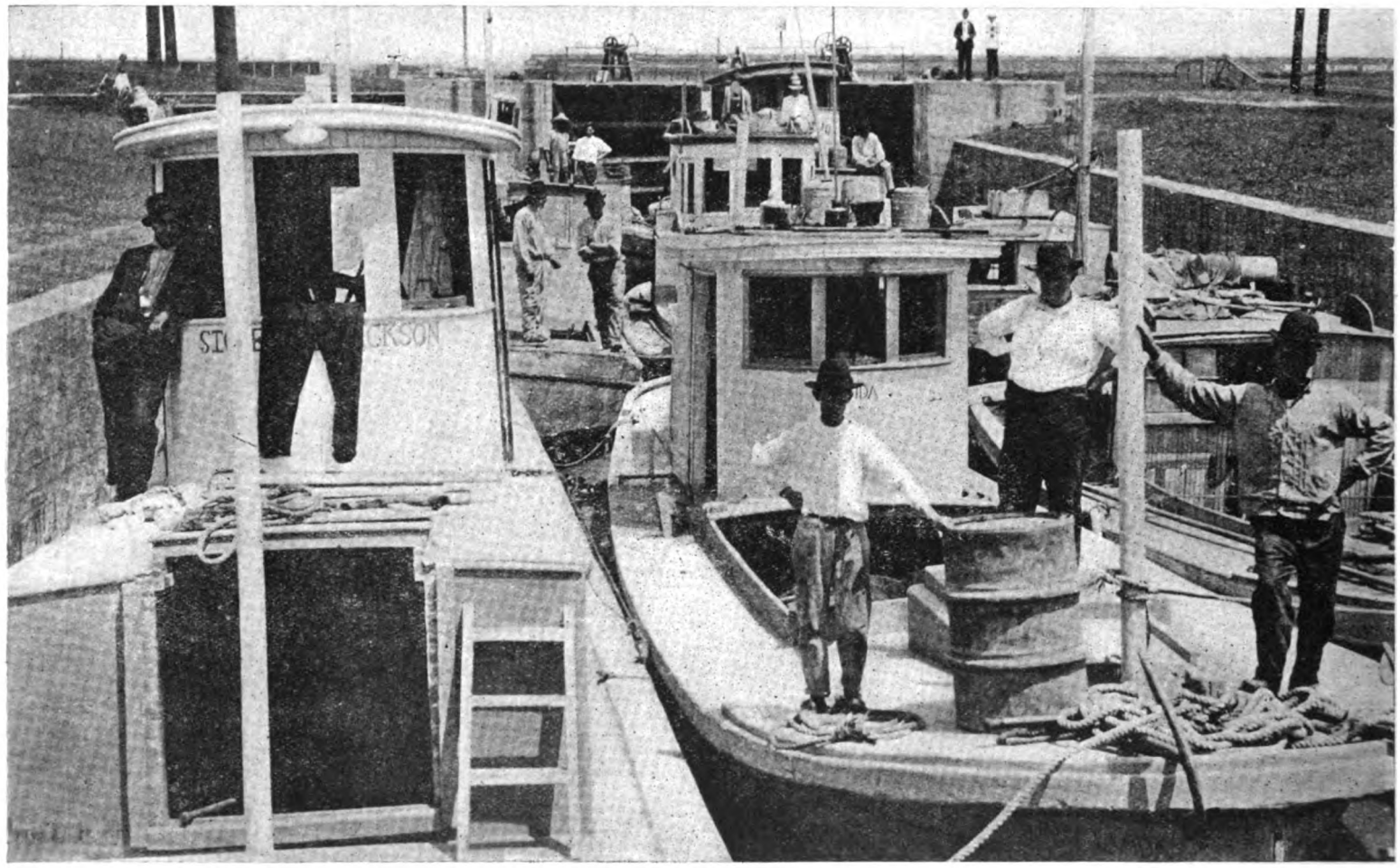
By HARRY H. DUNN

(Illustrated from Photographs by the Author)

PROBABLY the largest working motor-boat fleet in any one state of the Union, certainly the largest of any equal area in the world, is that which operates on the lower Mississippi river, the nearly 5,000 miles of navigable inland waterways of Louisiana, and the gulf of Mexico coast of the same state. In this fleet are approximately 1500 boats, ranging in value from $400.00 for the little "single-hander," as the one-man fishing boats are called, to big steel, self-propelled barges, which cost $60,000.00 apiece before the war, and probably are worth $80,000.00 or more today. The total value of this fleet is not far from $2,000,000.00, and I will venture to say that it earns half of its value every year, though there are no actual records or figures on which to base this estimate; it is merely the result of my observation of all kinds of small motorships, doing all kinds of work in all parts of Louisiana.

Last year, for example, this fleet, with headquarters in New Orleans, Houma, Morgan City, Lake Charles, Grand Isle and other points in Louisiana's intricate web of waterways, handled traffic in vegetables, potatoes, fish, shrimp, oysters and other sea-food, valued at more than $6,000,000.00, out of a total value of $8,000,000.00 for the state's production of these foodstuffs. From this it is not hard to see what an enormous percentage of the state's hauling this motor fleet did. In addition to this, the motor-boats carried about one-third of the state's production of sugar and rice to market; about one-third of the sugar cane of the many and extensive plantations was carried to the sugar mills on barges towed or pushed by motor-boats. They towed thousands of barrels of molasses in huge, covered barges, from these mills to the syrup factories in New Orleans. They brought hundreds, yes thousands, of tons of coal and pig iron and steel for our allies from the Alabama coal and iron mines to shipside and wharf at New Orleans, big steel barges, propelled by internal-combustion motors using breeze coke and manufacturing their own gas being used for this purpose.

And they handled tons on tons of merchandise back to the remote settlements and plantations



The "Potato Fleet" of motor-boats in the lock which connects Harvey Canal to the Mississippi river at New Orleans. These boats carried 170,000 bushels of potatoes to the New Orleans market in 1918

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of Louisiana, and to the smaller towns of Alabama and Mississippi, while they cut freight rates from 50 cents to $2.00 a ton below those of the railroads and from 50 cents to $1.00 a ton below those the river steamers and bayou packets could collect and live. A mighty factor in the economics of the state of Louisiana is this fleet of motor work-boats, and the state felt it last year when so many of the boys who had worked in the fisheries and in this motor workboat fleet were away at war. The state is feeling their return in a different and better way, for the motor workboats, with their returning masters and workers, have taken on new life this spring, as is attested by the fact that one dealer, A. Duvic, of New Orleans, in one month sold 70 Clay gasoline engines, ranging from 8 to 12 horsepower, for installations in the power workboats of this one state alone. In addition to this, these boats so well advertised themselves by their good work that Mr. Duvic ordered another carload of these engines, and has nearly all of them sold in advance. "Never," he said to me the other day, "have I seen the owners and operators of workboats so busy or so prosperous. Not in any one season in the twenty-five years I have been in this business have I seen motorboats put to so many commercial uses, nor have I ever seen the operations of this fleet expand so rapidly as they have this spring."

New Orleans has a population conservatively estimated at 400,000, including probably 150,000 negroes, whose buying power is as great, family for family, as is that of the whites, inasmuch as the negro workmen today are receiving better wages than ever, and habitually spend those wages more freely than do the white workmen. To this population of 400,000, the working motorboats brought approximately two-thirds of the seafood eaten in the city—a large quantity because New Orleans is a Catholic community, and at least once a week devotes a day to oysters, fish and shrimp, while there is large sale for all forms of sea food every day. To these 400,000, also, these motorboats brought 170,000 sacks of potatoes in about three months last fall, when the state was threatened with over-production of potatoes, and the newspapers campaigned against the profiteering retailers by persuading the producers to ship their crops of potatoes direct to the streets of New Orleans for sale. Again, to these 400,000, these motorboats brought one-half—a low estimate—of all the vegetables they consumed, and in the heat of summer in New Orleans, vegetables form a large part of the diet of every resident of the city.

The amount of sugar and rice they handled for New Orleans consumption will never be known, for it cannot be separated from the quantity of these two important food commodities they handled consigned to outside points. They brought in thousands of pounds of beef and poultry and game, not to speak of fresh domestic and wild fruits. As yet, I have not mentioned the thousands of passengers they carried to and from settlements and plantations in west and southwest Louisiana, whose only means of communication with the outside world is by motorboat over rivers, lakes, bayous and canals. Practically all the larger motor freight boats, and many of the oyster and shrimp runners, will carry passengers; some of them have good accomodations, and many have as regular schedules and "ports" at which to stop as did ever any river packet in the old days of successful steamboating on the Mississippi.

The auxiliary fishing fleet in the Bacy Bay at Biloxi, Miss., where an industry worth several million dollars annually has been developed by the use of these motor boats

The motor workboat fleet is divided, roughly, into three classes:

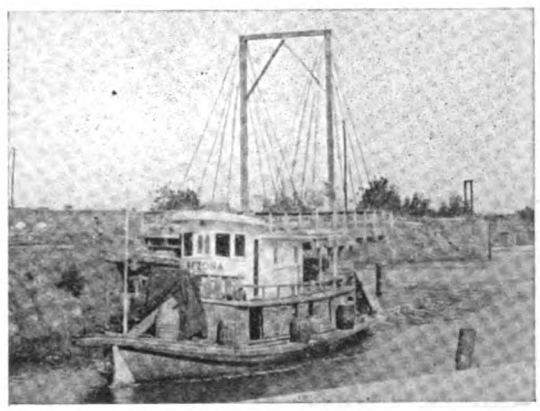
1—The fishing boats, which also carry freight on their return trips to the fishing villages and plantations en route.

2—The regular freight and passenger carriers.

3—Miscellaneous cargo boats, towboats, self-propelled barges, ship chandlers' packets, Sunday excursion boats, craft which carry fishing parties on trips to the lakes and back, and the auxiliaries.

A fourth class might be made of the fleet of twelve fast, armed motor-cruisers of the Louisiana State Department of Conservation, the "warships" of the motor workboat fleet, which keep watch and guard over the rights of the commercial fishing boats in the nearly 12,000 square miles of lowland and swamp of southwestern Louisiana. Of these, more later.

The fishing boats, which include the shrimp



"Rezona," typical motor freighter of the inland waterways of Louisiana. She is shown on the Barataria and La Fourche Canal

seiners, the market and cannery fishermen, the oyster luggers, and the slender, swift runners for all three classes, are the most important, and the most numerous. New Orleans is 110 miles from the gulf, if one follow the winding course of the Mississippi river. If you will run a straight line from New Orleans 225 miles west to a point ten miles up from the gulf on the Sabine river of Texas, you will have an enormous roughly triangular area of between 10,000 and 11,000 square miles, most of it too marshy to bear railroads, yet inhabited by probably 300,000 people, possibly more, whose work is fishing, truck gardening, farming, cattle raising, and, to some extent, sugar and rice production. More than two-thirds of the entire production of this large area is sent on motor boats to market, while approximately seven-eighths of the seafood output is handled in this manner. The fish, oysters, shrimp, crabs and turtles caught along the rim of the gulf, out on its waters and in the mainland bayous and bays are transferred from the auxiliary schooners, small motorboats and power luggers into which they are dumped from the seines, to the runners which make the hundred mile or more trip to New Orleans over the inland waterways and thence through Harvey or the Barataria and LaFourche canals to the westside of the river at New Orleans, or across the river to the Bienville street landing on the city side, though the latter is used mostly by the motor freighters, while the fish and shrimp and oyster boats unload their cargoes at Westwego or at Harvey, and the dealers ferry across the river with their low-priced motor trucks and make their purchases direct from the boats.

There are probable 700 to 750 of these boats operating in the various ends of the fishing industry. Most of the large auxiliary schooners are owned in Gulfport and Biloxi, Miss., where are located the packing plants for shrimp and oysters, though the larger part of both these seafoods are taken from the Louisiana marshes. It is impossible to enumerate the owners of these boats for there are as many men or families operating them as there are boats. They range in size from 25 ft. "speed"-boats, used as messenger craft for storm warnings and for picking up rush loads of oysters for the city market, to 100 foot lugger hulls carrying tons of oysters and shrimp and fish to the wholesale dealers of New Orleans, or to the shrimp and oysters packers at Biloxi, Gulfport, or the Crescent City. Their engines range from two and four horsepower to double forties, and virtually all these power plants are of the heavy duty type, with here and there a light, speedier engine in the messenger boats or the small oyster runners.

These engines are as various and as varied as their owners. Almost every type of working gas, kerosene and distillate engine on the market is represented, and each owner avers his is the best of the fleet. Habituated to silence by the silence of sea and marsh in which they work, there are only two subjects which arouse conversation even in a gathering of these fishermen and seafood runners—their engines and the last "pwice of s'wimp." And then the shrimp canner and the wholesale fish-dealer get theirs with a vengeance. The fisherman brings his fish, and shrimp, often 100 miles, to sell it for six or seven cents a pound for the former and two and one-half to three cents a pound for the latter, while the profiteering dealer sells it in his market, a mile or so away across the river for 40 cents a pound for the fish and 30 cents a pound for the shrimp.

In so far as the number of engines being adapted from what I can learn the Buffalo and the Clay are running a neck and neck race for leadership in engines of the larger boats, while the Gray is ahead in the smaller craft, with the even-higher powered Wintons, Wolverines, Frisco Standards, Frisbies, Fairbanks-Morse, and Automatics following through the various boats in about the order named. Many outboard motors of the several makes are also in use on the small boats used as tenders to the large fishing schooners and on some of the skiffs used by the individual fishermen who have not yet accumulated enough to own a share in one of the larger boats. Of course, much depends upon the energies of the various agents and sales-

Station of the Louisiana Department of Conservation in the New Basin Canal, New Orleans, with one of the department's patrol boats tied up beside it. This department is of great aid to the working motor-boat fleet, especially the fishermen

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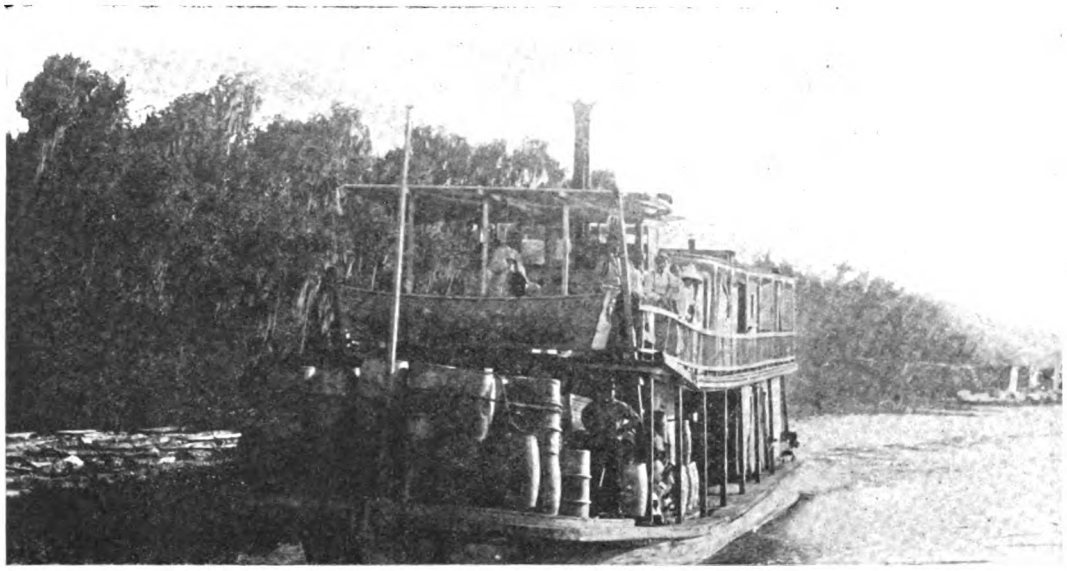
men, also on the value and amount of the publicity attained.

These fishing boats after bringing their catches to New Orleans or to other markets, carrying merchandise of all kinds, and even livestock, back to the remote fishing villages and settlements all through the Louisiana marshes. Their cargoes range from clothespins to cows, and many of them make a business of carrying a passenger or two into or out of the city, at a much lower rate, of course, than the few steamers make, or than the railroads can offer to the few towns to which they are able to operate in this large swamp area.

The few months of the year when shrimp are not running, when oysters are "milky" and not suitable for food, and when the demand for fish falls off, fortunately for these fishermen, are the months when the truck gardeners and the farmers of southwest Louisiana are producing the million dollars worth of vegetables. Then the motor work-boats reap a good harvest carrying the potatoes and the cauliflower and cucumbers and cabbages and egg plant and tomatoes to the shipping centers, whence the railroads can carry them to northern markets. From Grand Isle, one of the island outposts of the mainland in the Gulf of Mexico, 120 miles from New Orleans, an annual production of $350,000.00 worth of vegetables is sent to market by the 400 inhabitants. Seventy-five large work boats are continuously employed in this vegetable trade, or in the fish and shrimp and terrapin trade from this productive island.

Two of the Grand Isle fleet, which will serve for types, are F. & J., and "Chicago." The



"Hazel," of Louisiana, a type of freight carrying power-boat which has been profitable and successful

former is about 60 feet in length, driven by stern paddle-wheel, and powered with a 20-hp gasoline engine connected by belt to a chain gear. The "Chicago," which is about 50 feet in length, is screw-propelled and driven by a three-cylinder, 30-hp. Fairbanks-Morse oil engine, which sends her along loaded at about 9 knots. Another large industry, dependent entirely on motor-boats for its existence, is the growing of cucumbers, 60,000 crates of this vegetable having been produced there last year. Some of the individual growers maintain boats of their own; others club together and keep a boat to handle their several crops to market. Two such craft are "K. Adam," owned by Miss Mercedes Adam, one of the largest and most successful of all the "kuke" growers on the island, and "A.U.C." owned by the Chighizola brothers. These boats operate only about three months of the year, and are laid up the rest of the time. In the main, however, the vegetable-carrying fleet of power boats is busy the remainder of the year handling fish and other seafoods. John Ludwig, the only merchant on the island, owns "Chicago" and about a dozen other workboats, among them a fishing lugger which is busy all the year round supplying the 25,000 diamond-backed terrapins on his turtle farm with food. Ludwig's power boat fleet alone is valued at $25,000.

The second class of working boats, the regular freight and passenger carriers, are headed, as far as value, power and carrying capacity goes by the 250 to 700-ton self-propelled steel barges, installed in the coal and iron trade between the Alabama fields and New Orleans by the Alabama and New Orleans Transportation company some three or four years ago. This service was taken over with its six barges and one self-propelled harbor lighter and coal loader, by the inland waterways division of the government which is operating the towboat and barge service on the Mississippi river. These self-propelled barges are equippel with two 250-horsepower Fairbanks-Morse engines, operating on breeze-coke put through Galuda gas-producers on board. are connected to four screws, and their cost of operation is extremely low. The original cost of these barges was about $60,000.00 each, but they are doubtless worth at least $80,000.00 each today. They deliver coal to the tipples at Violet, a few miles down the river from New Orleans, whence the motor-driven lighter—equipped also with Fairbanks-Morse producer-gas burning engines—carries it to ships in mid-stream or on the water side at the wharves and distribute it by means of elevator and carriers evenly in the bunkers. One hundred tons per hour can be so handled. The government is successfully operating these barges.

The yard established for the construction and repair of these barges at Violet, also was taken over by the government, but later sold to the National Shipbuilding Company, of Three Rivers, Can., after the Alabama and New Orleans Transportation company had completed construction of four 2300-ton steel oil tankers, steam-propelled, for the Mexican Petroleum and Transport Co. It is understood that more of the barges will be built by the National Company, of which G. H. Brierton, formerly manager of the Alabama and New Orleans Transportation Company, is general manager. It is reported that experiments are being conducted with oil-engines with a view to installing them in the new barges, but the company has made no announcement regarding this step.

Next among these motor freighters come boats of the type of "F. & J." and "Chicago," already described. About 175 such boats, most of them smaller than either of these two, are in operation in Louisiana waters, and they have virtually put the old time river steamers out of business, though some of the packets are still in operation over the inland waterways and through the canals to New Orleans. Most of these, however, are of small size, some of them no larger than the largest of the motor freighters, slower, harder to handle and much more costly to operate. The motor freighters which run west from New Orleans, such as "Rezona" and "Hazel," both pictured herewith, are mostly of the lugger type, with the high bow and wide overhang, about equally divided between stern-wheelers and those with propellers. In some respects, especially for the shallow waters of many of the bayous, the stern-wheeler has an advantage over the boat with the wheel, but what the stern-wheeler gains in ability to penetrate remote and shallow waters, she loses in speed, the old law of compensation being as actively engaged in the motorboat industry as anywhere else.

As among the fishing, it is almost impossible to say which engine, if any, has the preference among the freighters. The same makes of motors as mentioned for the fishing and fish carrying fleet are in use among the freighters, and, as with the fishermen, most of the hulls are built along the bayous and rivers of Louisiana by men whose families have been building boats ever since the Sieur de Bienville started the boat yard industry by building two or three pinnaces at what is now Madisonville, with which to carry his band of adventurers across Lake Pontchartrain to New Orleans. And these boats are marvels of seaworthiness in the roughest weather. Never a storm sweeps the coast of Louisiana—and at least one hurricane blows in off the Yucatan Channel every autumn—but that they dash out into it, rescuing hundreds of lives, saving thousands of dollars worth of property, risking their own lives and their own boats, with no hope of reward other than to have it said throughout Evangeline's land that they did their best for men and women they had called friends for years. Seldom does one of these heavy, cypress-hulled freighters lose the battle to the storm, and when she does, none of the crew comes back. Quiet little descendants of the French Acadians, these, but they are the same kind of men who held the Hun hordes for three weary years. They are the poilus of the sea and the shallow, treacherous lakes and bays, and they wouldn't know the word "quit" even if they saw it the Bible.

Around the harbors and the towns works the third class of boats, the most difficult of all on which to accumulate any data, because they are fewer in number, their work less regular, and their owners most afraid of all of the invasion of their field by other motor-boats. They are the tow-boats, the ship chandlers' packet, the motor ferries, and the speed boats which a number of corporations operate between their New Orleans or Houma or Morgan City or Lake Charles packing plants or canneries, and the fishing settlements or shrimp villages far down toward the gulf. Of such, for instance, is "Brer Rabbit," the fast runabout used by Capt. R. R. Barrow, owner of the Barataria and LaFourche Canal, which connects 5,000 miles of inland waterways, clear from the Mississippi to the Sabine river in Texas, with New Orleans. Brer Rabbit is 35 feet long, 5 feet 8 inches beam, driven by a six-cylinder, 60-hp. Stevens-Duryea automobile engine, linked by universal coupling to a 19-inch propeller, which gives her driver most anything he wants from four to 20 knots. Much to the surprise of every man familiar with power boats who sees "Brer Rabbit," the auto engine is giving satisfactory service as a marine power plant.

There are a number of other boats of this type in this service as well as a few harbor tugs, the later increasing in number as owners learn their lower cost of operation and greater effectiveness over steam tugs for the handling of certain classes of harbor business. Flagship of this miscellaneous fleet is "Double-Trouble," also belonging to the Barataria and LaFourche Canal Company. She is a large scow-built craft, about 100 feet long, drawing three feet of water aft and three inches forward, with the wide overhang the builders of these boats have found most effective for keeping the water off the deck, and is the only motor-boat the writer has ever seen in the South which has two stern wheels, operating side by side, on separate shafts, so that one may be turned forward and the other back, holding her steady in any current, or turning her in her own length. Power is furnished by two Chartres engines, working independently, each connected to one of the paddle wheels by chain drive.

Far aft on "Double Trouble" is the large engine-room, cookhouse, cabin for the crew of ten, and above the wheel-house and the pilot and captain's cabins. There is, of course, no hold, and all freight, coal, etc., must be carried on the long deck. She serves as general freighter, she carries coal from New Orleans to the sugar mills down the canal, she takes on a pile driver and repairs bridges and locks, and, covered with movable screens in summer, she makes a commodious and safe houseboat for Captain Barrow and his family and friends in cruises to the Barrow summer home near Grand Isle and along the gulf coast. A motor-boat of more widely various uses and usefulness I have never seen.

In addition to all these work boats, there is the fleet which cares for and protects them in their industry, the 12 fast motor cruisers of the Louisiana State Department of Conservation. Armed with small rapid-fire guns and rifles, this fleet patrols day and night the shrimping grounds, the oyster reefs and the fishing waters of Louisiana, keeping watch that poachers from this and other states, who prefer stealing their catches to paying the state license, are kept off the fishing grounds of the men who operate the motor fishing fleets. Up the rivers and bayous these conservation department boats also run, pulling crippled workboats into port, helping them off mud banks, settling all manner of disputes over rates and charges,—in short, serving as a sort of Southwest Mounted Police, though their mounts are motor cruisers, and their wards the water industries of Louisiana.

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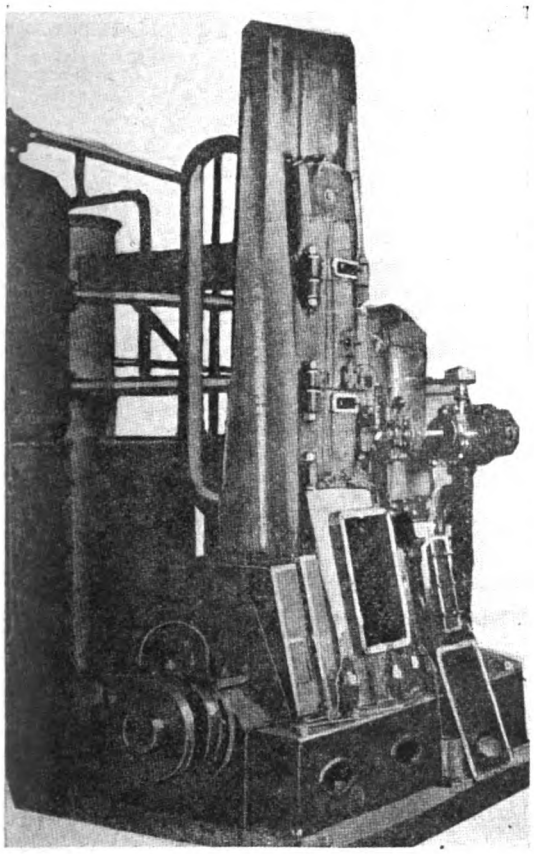
A New Prime Mover of High Efficiency

The Still-Acland Combination Steam and Diesel Engine—a Consumption of 0.302 per Shaft Horse-power Obtained

By FRANK E. D. ACLAND, M.Inst.C.E.*

THE reconstruction of industry, and the reparation of the damage and waste of war, are occupying, and must long continue to occupy, the serious attention of the civilized world. Economy and efficiency is the basis of prosperity, and industry will depend more than before on technical and scientific workers to ease its burden, shorten its hours of labor, and raise the living standard of those engaged in it.

There are two methods of producing power by the combustion of fuel—either under boilers or within the main cylinders of combustion engines. The steam engine exerts powerful starting efforts; operates at any speed from start to its designed maximum; can develop more than its rated power



The Still-Acland combination Diesel and steam engine

at reduced speed; can carry severe overloads for long periods, and generally gives ample warning before ceasing to operate: but this is accomplished with a loss of 80 per cent, at least, of the heat energy contained in the fuel supplied to it—a loss which is irrecoverable.

The internal-combustion engine shows a far higher heat efficiency, but cannot start itself without some external source of power; cannot develop its full power except at full speed; is a poor performer at very low speeds; so combustion engines have as yet supplanted steam but to a limited extent in marine and stationary engines.

The conversion of heat into useful work, with the minimum of waste, depends on the efficiency of the means employed, that is to say, it depends on the losses in the heat cycle, and on the losses in the mechanism employed for producing the heat and converting it into power.

The maximum ideal efficiency of a heat engine is obtained where the difference existing between the highest and lowest temperatures of the working fluid is greatest in proportion to the maximum temperature, and here the internal-combustion engine, with an initial temperature higher than the furnace temperature of the boiler, and even higher than the melting-point of cast iron, is capable of realizing better thermal conditions than any other form of heat engine; but in its turn it suffers from two disadvantages—it ejects its working fluid at a temperature too high for ideal conditions, and it loses heat energy to a regrettable extent in the cooling of its cylinder.

The result obtained in practice from the two cycles separately based on their best performances after half a century of intensive development, is that in the steam engine there is a loss of over 80 per cent of the heat contained in the fuel, and in the combustion engine of 60 per cent.

The recovery and efficient use of the waste has been the work of many years of patient research by William Joseph Still and others associated with him, and has resulted in the design and construction of a variety of engines which point to a vast field of further practical application. The results already obtained from engines which are admittedly experimental types, constructed under disadvantageous conditions, are sufficiently remarkable to substantiate their claim to be of real importance.

The possibility of combining in one engine the superior thermal cycle at the high temperatures and pressures of the combustion engine with the low thermal cycle of steam to deal with its rejected heat, and, in the same engine, add the working advantages of the steam engine, was the basis of his work.

The development of the internal-combustion engine has included many proposals and attempts to utilize the heat going to waste in the exhaust and cooling water; but while in existing engines some proportion of the heat can be usefully recovered as steam from the exhaust gases, the cooling water from the jacket is of little value, owing to its low temperature, and the efficiency of the engine itself is not augmented. If, however, the temperature of the cooling water could be maintained at that of steam at useful pressure, the efficiency of the engine would be improved and the weight of steam be usefully increased.

The Still engine makes use of the recoverable heat which passes through the surfaces of the combustion cylinder, as well as into the exhaust gases, for the evaporation of steam, which steam is expanded in the combustion cylinder itself on one side of the main piston, the combustion stroke acting on the other side. It increases the power of the engine, and reduces the consumption of the fuel per horse-power developed.

Internal-combustion engines are kept cool by the circulation of cold water round their cylinders; the heat thus absorbed causes a rise in temperature of the water as it travels through the jacket, so that the cylinder is subjected to temperature differences and heat stresses, which are an abiding source of trouble and difficulty to the designer.

In the Still engine the jacket and cooling water form part of the circulating system of a steam generator, which may be an integral part of the engine, or external to it. The cooling water therefore enters and leaves the jacket at a constant temperature, regulated by the pressure of the steam; the cooling being effected by converting the water into steam without raising its temperature. Excluding the radiation losses, which are kept low by lagging, all the heat which passes through the walls is thus usefully recovered in the water as steam. The temperature of the cylinder wall is uniform over the whole of its exterior surface, and the heat lost to the cooling water at each stage of the cycle—compression, combustion, and expansion—is diminished.

During compression, owing to the walls being at steam temperature, the incoming charge picks

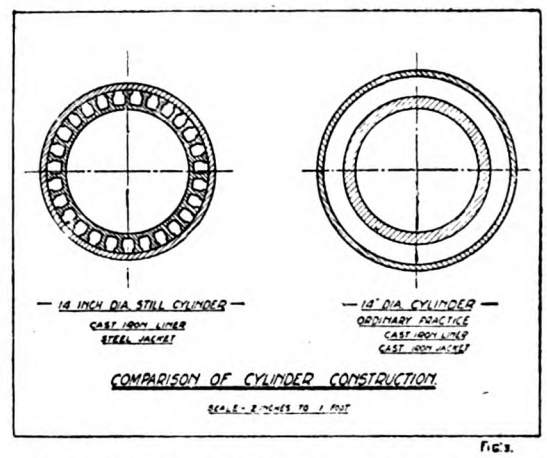


FIG. 1.

up heat, instead of losing it, during the greater part of the stroke, an advantage of the greatest value to the heavy oil types of Still engines, where an air charge is taken it at the full out-stroke, and is compressed to a pressure where its increased temperature ensures the certain ignition and combustion of the fuel which is injected into it.

During combustion and expansion, the uniform and higher mean temperature of the walls reduces the heat lost to the jacket water. Some of the heat thus economized adds to the useful work on the piston, the balance passing out in the exhaust gases for recovery.

To ensure the maintenance, in a practical and reliable manner, of the temperature conditions which produce this efficiency during the combustion cycle, a departure from the design and construction of the cylinders of normal internal-com-

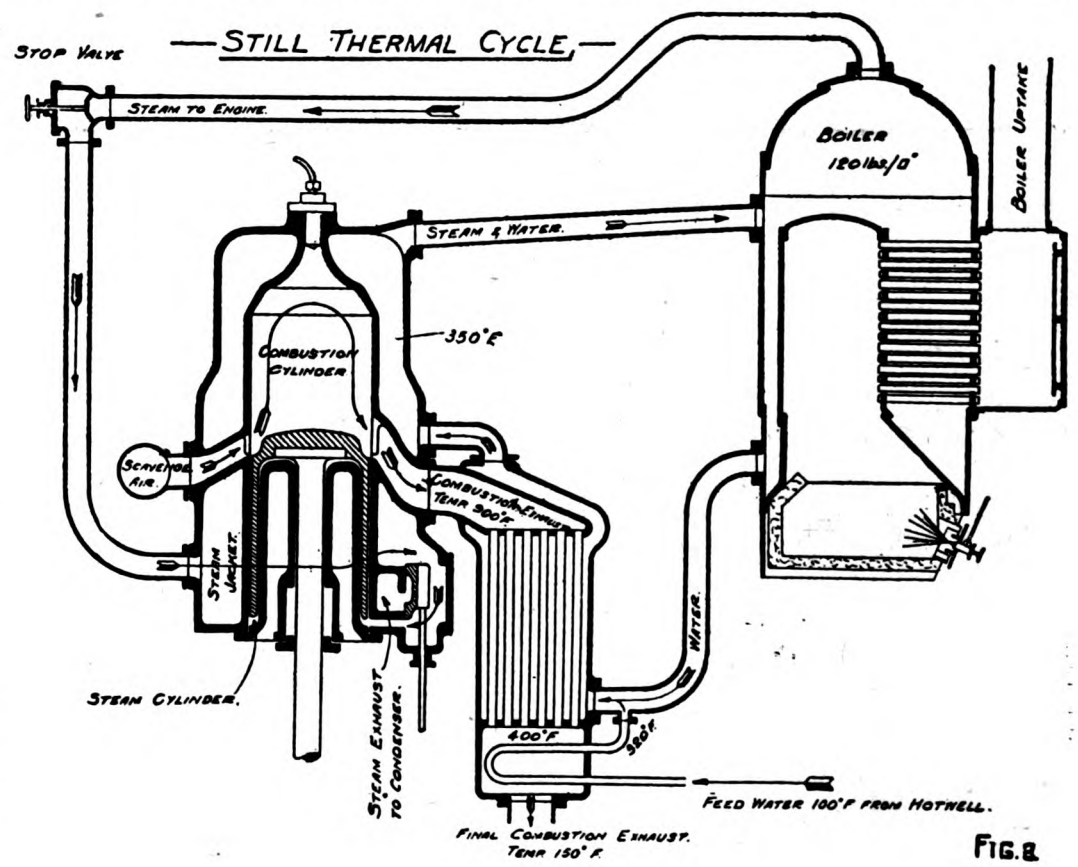


FIG. 2.

*Extract from paper read before the Royal Society of Arts (England) on May 26th, 1919.

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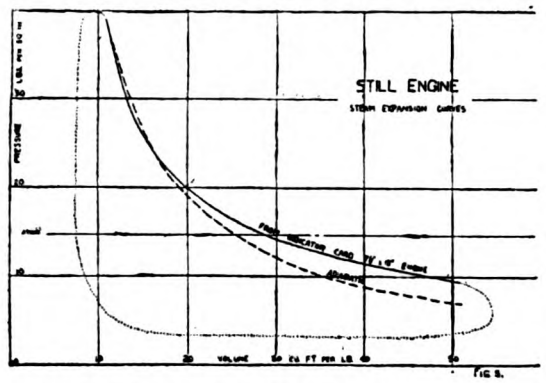
bustion engines is imperative; they have hitherto been made of cast iron, of a thickness sufficient to resist the working and thermal stresses thrown upon them, including occasional heavy loads caused by pre-ignition of the explosive charge. With these thick walls or liners, the temperature difference between their inner and outer surfaces, which is essential if the surplus heat is to be carried off, can only be obtained safely by the circulation of water at low temperature through



the jacket; this is especially the case in cylinders of considerable diameter, or capable of high power per swept volume.

The cylinder of a Still engine consists of an inner liner, which is approximately one-third to one fourth of the usual thickness; it is ribbed externally so as to add to its conducting surface and to provide suitable passage for the cooling water, and it is reinforced by an outer hoop capable of withstanding the highest pressures to be met in working. The stresses due, in ordinary practice, to the cold water at the inlet, and the hotter water at the outlet, are suppressed in the Still cylinder, the cooling water being at a controlled and uniform temperature throughout.

No failure of a cylinder of any kind has occurred, even under most severe and abnormal test conditions, *e.g.* with mean combustion pressures of 180 lb. per square inch in a two stroke engine, to which was added overload steam mean pressure of 70 lb., *i.e.*, a total m.e.p. per revolution of 250 lb. per square inch.

Jacket.—The Still engine may be of the constant volume or constant pressure type, or a combination of both; its losses to the cooling water are not the same as in a normal engine of either type, except in so far that they vary with the type, with the cycle, with the efficiency of the combustion stroke, and with the load. At normal and full loads, such heat units, in a Still engine, as pass into the jacket water, which is at steam temperature and pressure, are lessened and are wholly recovered without loss—radiation excluded—in overcoming the latent heat of the water and give off their steam in the steam space in proportion to the heat flow at those loads. At lower loads less steam is produced, until at still lower loads no steam at all is measurable. In other words, the jacket losses are practically eliminated.

The exhaust gases take a subsidiary, but important part in the cycle; their usefulness in ordinary combustion engines, in raising steam, is limited to the amout of heat recoverable between the initial temperature of the exhaust and that of, say, 50° F. above the steam temperature, after which the whole volume passes away to atmosphere at a still useful temperature, less a small percentage available for feed-water heating. But in the Still engine, the exhaust gases, after raising their quantum of steam, are employed in preheating all the water required for the steam generated in the jacket water and in the generator. Trials at full efficiency over long periods and steady loads, show terminal stack temperatures as low as 150° F. The heat efficiency of the combined cycles is therefore exceedingly good, with an inital temperature of over 2,000° F., and a final exhaust to atmosphere at 150° F.

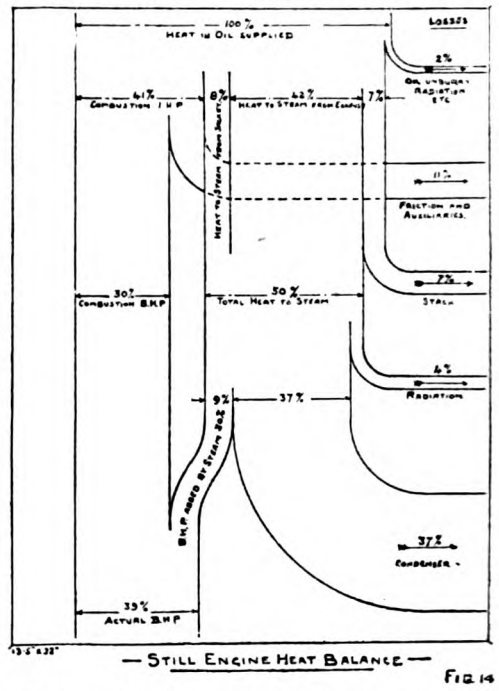
The quantity of steam capable of being generated from "waste heat," depends upon the efficiency of the combustion cycle, and on the load. Some years of experimental work prove that the weight of steam recovered may vary from a maximum of about 7 lb. per b.h.p. hour, developed by the combustion cycle of a four-stroke constant volume engine, at full load, to a minimum at light loads which is hardly measurable, and which only balances the loss due to radiation.

Steam: Use.—The steam thus recovered is a by-product, is limited in amount, and its value depends upon the efficiency of its employment. This is carried out in a logical manner. In place of being expanded in external auxiliary engines, with their thermal and mechanical losses, it is returned to the combustion cylinders of the Still engine, and is expanded on the opposite side of its main piston, one stroke being performed by steam and the other by combustion.

The piston and cylinder walls, pre-heated by the combustion stroke, are at a higher temperature than the steam when it is admitted and while it is being expanded; there is, therefore, no loss from condensation, and the steam exhausts at a slight superheat above the normal expansion temperature, a condition which is unattainable in any form of steam engine without direct loss of energy With an early cut-off, the steam can be expanded economically right out to atmospheric pressure, or below it, and be either re-compressed (Stumpf cycle) or exhausted to condenser. The steam, during expansion, forms an efficient means of cooling the piston.

It may be convenient, at this point, to interpolate a few lines on condensing and compounding, either wholly in the Still engine itself, or in external high-pressure cylinders compounding to low-pressure Still cylinders on the same shaft. These separate high pressure and intermediate pressure cylinders will meet special conditions, and have been found of utility where manœuvring or starting in any position is required for single or twin combustion cylinder sets; but for a better arrangement in multiple cylinder sets of Still engines is to use the high pressure steam in one of the cylinders at the back of the piston, and compound into similar adjacent cylinders. Many variations of these arrangements suggest themselves. The steam is usually exhausted to a condenser, but it can, in special cases, be employed in low-pressure turbines, or made use of in connection with producer gas auxiliaries.

The effect of the steam in its co-operation with and re-action on the combustion cycle, has been



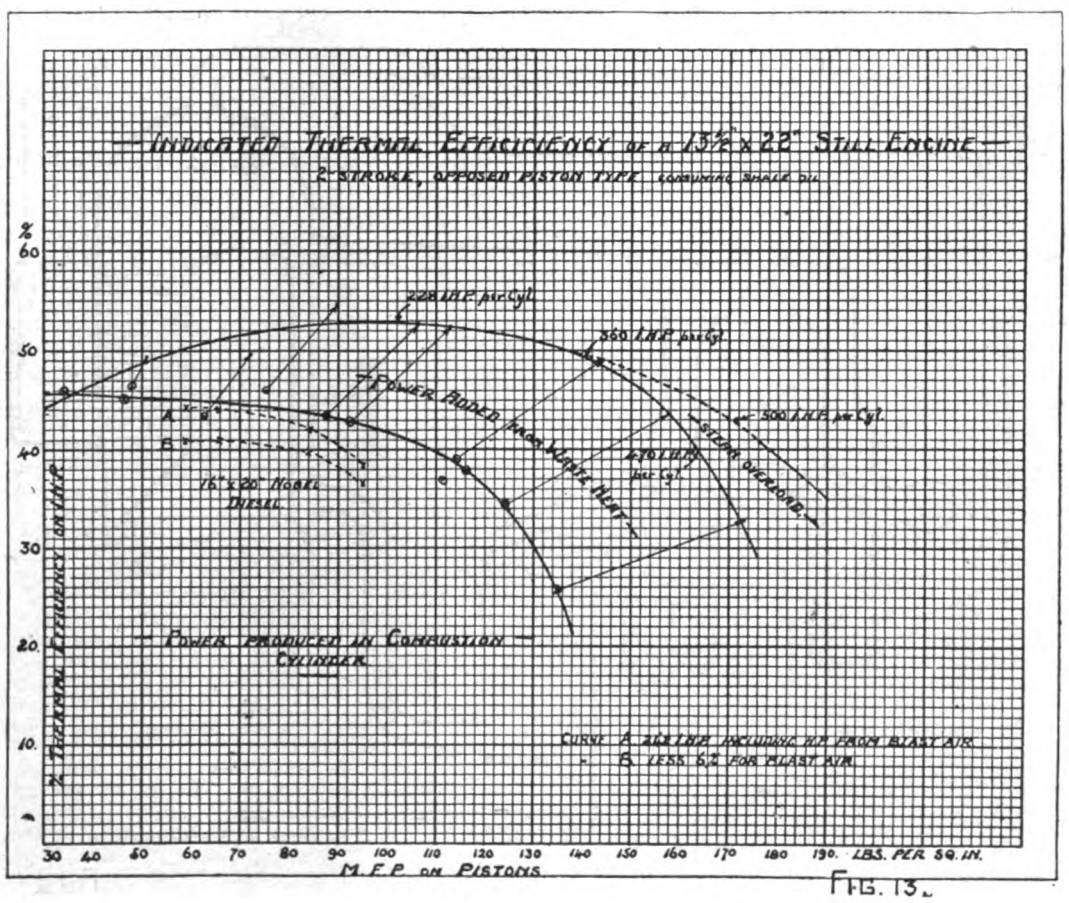
the subject of many series of exhaustive tests.

The engine used for this research was the constant volume type, four-stroke. It first underwent a series of tests, so as to arrive at its "initial horse-power" as an explosion engine, *i.e.* without any power added by the steam cycle, and was carefully checked in this connection by comparison with well-known and authenticated trials carried out by the late Professor Bertram Hopkinson, F.R.S., and others.

The quantity of steam generated per "initial brake horse-power' from the jacket alone, averaged 3.28 lb. per b.h.p. hour, and from the jacket and exhaust together 6 lb. per b.h.p. hour, this being the average of the whole of the trials over periods varying from twenty minutes to over six hours. The final six hours of a seven and a half hours' continued test, gave a total recovery of 6.9 lb. of steam per initial b.h.p. A whole series of these early trials was carried out under the supervision of C. Vernon Boys, F.R.S.

Normal Load.—The average m.e.p. from the combustion stroke was 90 lb. per square inch. The steam evaporated by the "waste heat" gave 14 lb. per square inch m.e.p. on every return stroke. This is equivalent to 90 + 28 = 118 lb. per square inch m.e.p. in a normal four-stroke engine.

Overload.—By admitting additional steam generated by fuel under the boiler, the steam m.e.p. was raised to 72 lb. per square inch; the total m.e.p. was, therefore, equal to 90 + 144 = 234 lb. per square inch m.e.p. in a normal four-stroke engine.


— INDICATED THERMAL EFFICIENCY OF A 13½" x 22" STILL ENGINE —
2-STROKE, OPPOSED PISTON TYPE. COMBINING DIESEL OIL
% THERMAL EFFICIENCY ON I.H.P.
228 I.H.P. per Cyl.
365 I.H.P. per Cyl.
500 I.H.P. per Cyl.
POWER ADDED BY MACMAHON HEAT
EXCESS I.H.P. per Cyl.
STEAM OVERLOAD
16" x 20" NOBEL DIESEL
— POWER PRODUCED IN COMBUSTION CYLINDER.
CURVE A. AIR I.H.P. INCLUDING AIR FROM BLAST AIR.
B. LESS 6.2 FOR BLAST AIR.
M.E.P. ON PISTONS
LBS. PER SQ. IN.
FIG. 13.

Oil Engines

The Still oil engine starts with the cylinders and pistons pre-heated. The air charge, from the moment of its entry into the cylinder, picks up heat from the containing walls and continues to do so during at least 70 per cent of the compression stroke, with the result that the temperature necessary for firing with certainty the first injected charge of fuel is reached with a compression pressure 50 per cent less than that required in a Diesel engine.

[If this is correct, it means a cylinder compression of less than 250 lbs. for the Still oil-engine.—**Editor.**]

It claims for its combustion cycle an efficiency higher than that of the Diesel, less weight and space per horse-power, and for its combined cycle an efficiency not less than 20 per cent higher than any prime mover which uses fuel as its source of heat.

[Against this must be offset the waste of fuel-oil required to constantly maintain a head of steam in the boilers when the ship is in port.—**Editor.**]

The first engine designed for the use of heavy oil was of the opposed piston type, 16 in. diameter, 32 in. total stroke, revolutions 150, the combustion taking place between the two pistons with the steam generated by the jacket water and

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exhaust gases expanded at the back of both pistons (the steam passed from the auxiliary boiler through h.p. and l.p.. cylinders and finally to the Still engine as an l.p. cylinder), and thence to the condenser.

The steam h.p. and l.p. cylinder was connected to a prolongation of the main shaft at 90 degrees to the main crank; all auxiliaries were separately driven, thermo-couples were connected to all important points in the plant between the combustion space and base of stack. The oil was injected by blast air, scavenge by a fan, pressures from .5 to 1 lb. per square inch. It was fitted with a brake and fly-wheel of 4¼ tons weight; from full power (300 b.h.p. at 160 revolutions) it will reverse by a single lever from ahead to astern in ten to twelve seconds.

The characteristics of the cylinder were:—Bore, 13½ in.; stroke, 22 in.; two-stroke cycle, opposed pistons; steam side as for l.p. cylinder. It forms the basis of a six-cylinder set, two of them using h.p. steam, which is compounded into the other four as l.p.

The combustion takes place between the pistons, the steam acting on the return stroke at the back of both pistons. After a series of preliminary tests under steam alone, in which data was obtained for the various mechanical adjustments, the scavenge, compression pressures and temperatures at various speeds, oil was injected for the first time. The engine fired its first charge without hesitation, and completed a series of tests of over two hours' continuous running, without adjustment, giving an output by gradually increasing the weight of oil admitted of 100, 150, 200, etc., up to 400 i.h.p. at a maximum speed of 380 revolutions per minute, for which she was designed. The governing of this engine is best demonstrated by Fig. 11, which gives a set of cards ranging from 23.5 lb. per square inch to 141 lb per square inch m.e.p., produced by the combustion cycle alone. This series of cards can be obtained at a constant or varying speed, progressively, from maximum to minimum or *vice versa*, or from extreme to extreme without any interval.

This unit has been subjected to many long and varied tests by representatives of various Governments, as well as to constant research work under severe conditions. Its best consumption of fuel (Admiralty shale oil) has been as low as 0.302 lb b.h.p. (scavenge pump not included), over a test of one hour's duration under normal waste heat conditions. It developed 330 b.h.p. for six hours at 360 revolutions per minute (a single cylinder) under waste heat conditions. It will develop 400 b.h.p. continuously with added steam, and has developed 540 b.h.p. at 380 revolutions over short periods. (Combustion m.e.p. 128.2 lb., steam m.e.p. 57.9 lb. total m.e.p. 186.6 lb.). The thermal brake efficiency from below quarter load to full power is maintained at approximately 40 per cent over the whole range.

With added steam from the boiler, 5,000 b.h.p. would be obtained from two six-cylinder sets, with a weight of about 70 tons, including all auxiliaries and water, and extreme overloads up to 6,000 b.h.p. could be obtained.

The application of the Still system to commercial marine work is being developed in Great Britain and other countries; the two stroke single piston type, in powers of 100 h.p. per cylinder and 400 h.p. per cylinder, having been adopted.

Engines of this type at 120 revolutions per minute, with a cylinder 22 in. diameter by 36 in. stroke, giving 4,200 s.h.p. on two shafts, with all auxiliaries and water, would approximate 600 tons. A geared turbine plant in a similar ship would weigh 20 per cent more, and would consume approximately 2,000 tons more fuel for a double journey lasting 1,000 hours.

Science and practice, like capital and labor, must work hand in hand. It is satisfactory, therefore, to state that in practice the Still engine can claim that it has carried out completely the objects of its inventor, and has corroborated and confirmed the principles on which he has worked.

These may be summarized as follows:—

1. The higher mean temperature of the engine makes the combustion cycle more effective and more reliable in starting and in running.
2. The Mechanical stresses due to heat are reduced.
3. The steam generated by the heat rejected by the combustion cycle augments the power of the engine without increasing the consumption of fuel.
4. The steam generated by the heat rejected by the combustion cycle cools the piston.
5. The steam generated by the heat rejected by the combustion cycle reduces the mechanical losses of the engine.
6. The steam generated by the heat rejected by the combustion cycle is used under exceptionally favorable conditions, since it absorbs heat during expansion.
7. The steam generated by the heat rejected by the combustion cycle suffers no condensation loss in the working cylinder.
8. The steam generated by the heat rejected by the combustion cycle warms the engine before starting, so that no sudden temperature changes occur in any part.
9. The steam generated by the heat rejected by the combustion cycle starts the engine against load if necessary.
10. The steam generated by the heat rejected by the combustion cycle enables manœuvring at any speed from nothing to maximum and for any period.
11. Starting is unaffected by atmospheric conditions.
12. Power at normal loads is developed by combustion and steam from waste heat alone, with an efficiency at least 25 per cent above any known combustion engine of similar proportions.
13. Since the steam raised by the waste heat is more than enough to overcome the mechanical losses of the engine, the b.h.p. of the engine is at least equal to the i.h.p. produced by the combustion stroke.
14. Additional steam gives a large range of overload without serious loss in efficiency.
15. In engines using heavy oil as fuel, the compression pressures which ensure the ignition can be reduced by 50 per cent, as compared with the Diesel system.

If the Still engine, in its infancy, has been able to show, in spite of the limitations of its upbringing, improvement in the thermal conditions, balance, torque, manœuvring power, overload and fuel consumption, with less weight and space for the power it develops, it can look forward with some confidence, now that it can pass through the severe school of the engine shops of the world, to an adolscence of great promise, and it would be unwise to say what may be the limit of its ultimate career..

[About two years ago important American interests made an exhaustive investigation of the Still-Acland engine, but as no further steps were taken we presume that it was considered that the engine had not sufficiently passed the experimental stage to warrant its construction commercially.—**Editor.**]

SURFACE-IGNITION TYPE MARINE OIL-ENGINES OF THE WORLD.

(Excluding Germany)

In our issue of May, 1919, we published a complete list of Diesel-type marine oil-engines of the world. We now supplement this useful information with a list of marine oil-engines of the surface-ignition class. Altogether there are no fewer than 127 concerns constructing this class of engine; and, as there were 83 Diesel marine engine builders given in our previous list, it will be realized that the marine heavy-oil engine industry has become of the very greatest importance.

However, as in the case of the Diesel engine list, a few of the firms have done little or nothing in the way of actual commercial construction. Owing to the great difficulties in securing accurate information it is possible that some of the firms referred to in this list may be agents and not manufacturers, and there may be a few incorrections in the spelling of the foreign names. We will be glad to receive additions and corrections.

FURTHER GOOD WORK BY THE M. S. "CALIFORNIA"

In our January issue of Motorship we gave a detailed and complete history of the economical operation of the veteran Danish motorship "California." This record extended from 1913 to Nov. 1918, up to her arrival in the port of New York. Subsequently she has made one trip to Buenos Aires and return, being held up at that port three months on account of the serious harbor strikes and general labor conditions. We again made a visit to this ship and the Chief Engineer, Mr. Hendricksen, stated that on the return voyage she logged 5,960 miles in twenty-four days. The cargo was mostly wool and hides amounting to 6,000 tons net. From the sixteen working-cylinders in the two engines they have had no trouble whatever during the round trip except one fuel-valve—easily and quickly replaced by a spare. The above figures show a sustained non-stop sea speed of 10.3 knot, a pleasing performance from a vessel which has not seen a home port and we judge a drydock in two years.

"Motorship" hopes in the case of the M.S. "California" and similar vessels, to follow and publish for the information of its readers the true account of actual performances so as to form a continuous record of such ships and not merely to emphasize isolated and particularly economical runs. The M.S. "California will leave New York for a return trip to South America and then will return to Copenhagen before visiting our shores again. We will endeavor to pick-up the thread of the record and bring it up-to-date at that time.

SURFACE-IGNITION TYPE MARINE OIL-ENGINES OF THE WORLD
(Excluding Germany and Austria-Hungary)

THE UNITED STATES OF AMERICA

Name	City	Design	Type
Blanchard Machine Co.	Cambridge, Mass.	Blanchard	2-cycle
Burnoil Engine Co.	South Bend, Ind.	Burnoil	2-cycle
Carlson & Russ	Port Richmond, N. Y.	Carlson & Russ	2-cycle
Fairbanks Morse Co.	New York City, N. Y.	Fairbanks-Morse	2-cycle
Marine Mechanical Works	Los Angeles, Cal.	Gaertner	2-cycle
Guyler-Bergh Co.	Mobile, Ala.	Guyler-Bergh	2-cycle
R. M. Hvid Co.	Chicago, Ill.	Hvid-Brons	4-cycle
St. Marys' Co.	St. Charles, Mo.	Hvid-Brons	4-cycle
Davis Mfg. Co.	Milwaukee, Wis.	Hvid-Brons	4-cycle
Evinrude Motor Co.	Milwaukee, Wis.	Hvid-Brons	4-cycle
Minneapolis Steel & Iron Works	Minneapolis, Minn.	Hvid-Brons	4-cycle
Pittsburg Filter Mfg. Co.	Pittsburgh, Pa.	Hvid-Brons	4-cycle
Bates & Edmonds Co.	Lansing, Mich.	Hvid-Brons	4-cycle
Midwest Engine Co.	Indianapolis Ind.	Hvid-Brons	4-cycle
Western Machinery Corp.	Los Angeles, Cal.	Hvid-Brons	4-cycle
Sears, Roebuck & Co.	Chicago, Ill	Hvid-Brons	4-cycle
Riverside Engine Works	Oil City, Pa.	Hvid-Brons	4-cycle
Quale Motor Co.	Chicago, Ill.	Hvid-Brons	4-cycle
Ingram Hatch Motor Corp.	New York City, N. Y.	Hatch	2-cycle
Jacobson Gas Engine Co.	Saratoga Springs, N. Y.	Jacobson	2-cycle
Kahlenburg Bros.	Three Rivers, Mich.	Kahlenburg	2-cycle
Lazier Gas Engine Co.	Buffalo, N. Y.	Lazier	2-cycle
Miller Engine Co.	Chicago, Ill.	Miller	2-cycle
Missouri Oil Engine Co.	St. Louis, Mo.	Missouri	2-cycle
August Mietz Corp.	New York City, N. Y.	Mietz	2-cycle
Remington Oil Engine Co.	New York City, N. Y.	Remington	2-cycle
*Rathbun Jones Engineering Co.	Toledo, Ohio	Rathbun	4-cycle
*Ingersoll Rand Co.	New York, N. Y.	Price-Rathbun	4-cycle
Stanley Company	Salem, Mass.	Stanley	2-cycle
Wolverine Motor Works	Bridgeport, Conn.	Wolverine	4-cycle
Mechanical Engineers Investing Co.	Los Angeles, Cal.	The F. W.	2-cycle
Venn Severin Machine Co.	Chicago, Ill.	Venn-Severin	2-cycle
Marburg Bros.	New York City.	Woxna	4-cycle
*P. R. Engine Corp.	Philadelphia	Price-Rathbun	4-cycle
H. W. Sumner Co.	San Francisco	Sumner	2-cycle

*Practically semi-Diesel engines.

GREAT BRITAIN

Aster Engineering Co.	Wembley (London)	Aster-Cross	2-cycle
Ailsa Craig Motor Co.	London	Ailsa Craig	2-cycle
A. W. Bradbury	London	All-British	2-cycle
W. Beardmore & Co.	Dalmuir	Beardmore	2-cycle
J. W. Brooke & Co.	Lowestoft	Brooke	2-cycle
Blackstone & Co.	Stamford	Blackstone	2-cycle
Campbell Gas Engine Co.	Halifax	Campbell	2-cycle
J. W. Coates	Manchester	Coates	2-cycle
Westinghouse Brake Co.	London	Cross-Westinghouse	2-cycle
W. & S. Pollock & Co.	Glasgow	Clyde	2-cycle
Griffin Engineering Co.	Bath	Griffin	2-cycle
Norris, Henty & Gardners, Ltd.	London	Gardner	2-cycle
Grampian Engine & Motor Co.	Stirling	Crampian	2-cycle
H. Widdop & Co.	Keighley	Invincible	2-cycle
Plenty & Co.	Newbury	Kromhout	2-cycle
Mitcham Motor Co.	East Cowes	Mitcham	2-cycle
Torbinia Engineering Co.	Lowestoft	Nat	2-cycle
Petters-Vickers, Ltd.	Ipswich	Petter	2-cycle
Petters, Ltd.	Yeovil	Petter	2-cycle
Simpson & Strickland	Dartmouth	S. S. Standard	2-cycle
W. F. Thomas	St. Helens	Thomas	2-cycle
Penney & Co., Ltd.	Lincoln	Penney-Porter	2-cycle

HOLLAND

J. H. Von Capellan	Bolnes	Bolnes	2-cycle
John Boot	Alphen	Boot	2-cycle
Bronsmotorenfabrik	Appingsdammer	Brons	2-cycle
D. Goodkoop, Jr.	Amsterdam	Kromhout	2-cycle
Steywal Motorenfabrik, ex Steljaard & Janette Walen	Rotterdam	Standard	2-cycle
Van Rennes Motor Co.	Utrecht	Van Rennes	2-cycle
Gasemstoran-Fabrik Deutz	Filicial nr. Amsterdam	Deutz	4-cycle
Motorfabrik Concordia	Amsterdam	Concordia	2-cycle

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DENMARK			
Houmoller Bros.	Aarhus	Alpha	2-cycle
Jorgensen & Co.	Copenhagen	Dan	2-cycle
A/S Motorfabriken Dan.	Copenhagen	Dan	2-cycle
Densil Motor Works.	Aalborg	Densil	2-cycle
H. Christoffersen.	Holeby	Holeby	4-cycle
H. Hein & Sons.	Strommen-Randers	Hein	4-cycle
A. B. Frederikshavna Jernstoberi & Maskinfabrik.	Fredrikshavn	Houmoller-Alpha	2-cycle
"Jan" Motorfabriken.	Fredrikstad	Jan	2-cycle
Kalunborg Motorfabrik.	Kalundborg	Kalunborg	2-cycle
A/S Nordan Motorfabrik.	Copenhagen	Nordan	2-cycle
P. R. Engine Corp.	Willadsen	Price-Rathbun	2-cycle
Tuxham Engineering Works.	Copenhagen	Tuxham	2-cycle
FRANCE			
Delauny-Belleville Co.	St. Dennis-sur-Seine	Delauny Belleville	2-cycle
Societe de Constructe Boulonnaise des Moteurs Pour La Marine et de l'Industrie.	St. Omer	Guldner	4-cycle
C. Bonnet.	Paris	Langoustier	2-cycle
Millot & Cie.	Gray, Haute-Saone	Millott	2-cycle
T. Robatel, J. Buffand & Cie.	Lyons	Standaard	2-cycle
Construction Boulonnaise d'Moteurs Pour la Marine et D'Industrie.	Bologne-Su-Mere	Standaard	2-cycle
Thomes & Le Marichal.	Caen	Triton	2-cycle
Establissements de Material Naval & Industrial Arthur Spangsburg.	Paris	Munktells	2-cycle
Schneider et Cie.	Harfleur	Schneider	2-cycle
SWEDEN			
Svenson's Motorfabriken.	near Stockholm	Avance	2-cycle
A. B. Hjorth & Co.	Stockholm	Avance	2-cycle
Bolinder & Co.	Stockholm	Bolinder	2-cycle
A/B Bofors Gullspang.	Bofors, Karlskroga	Brons	2-cycle
A/B Bofors Gullspang.	Bofors, Karlskroga	Leissner	2-cycle
Nichels & Todson.	Stockholm	Drott	2-cycle
Ljunggrens Verkstad Aktiebolag.	Kristianstad	Dux	2-cycle
Gamma Oil Engine Works.	Falum	Gamma	2-cycle
Ekman & Co.	Gothenburg	Gamma	2-cycle
Fritz Egnell.	Stockholm	Hexa	2-cycle
A. B. Ideal Motor-Fabrik.	Goteberg	Ideal	2-cycle
Aktiebolaget Nordinska.	Stockholm	Loke	2-cycle
Bergsunds Verkstads.	Stockholm	Original	2-cycle
Lysekils MEK Verkstad.	Lysekil	Skandia	2-cycle
Elkman & Co.	Gothenburg	Gamma	2-cycle
Motala Verkstad.	Motala	Svea	2-cycle
A. B. Lusne.	Woxna	Woxna	4-cycle
Egnell & Co.	Marstrand	Marstrand	2-cycle
RUSSIA			
The Dvigatel Co., Ltd.	Reval	Orel	2-cycle
CANADA			
North Shore Iron Wks., Ltd.	North Vancouver	Cochner	2-cycle
Heaps Engineering Co., Ltd.	West Vancouver	Heaps	2-cycle
AUSTRALIA			
Thompson & Co.	Castlemaine	Thompson	2-cycle
Anderson, Ltd	Christchurch, N. Z.	Anderson	2-cycle
NORWAY			
Nils N. Finnoy Motor Wks.	Romsdal	Finnoy	2-cycle
Crigstrup Mek Verksted Favorit Motor Wks.	Molde	Favorit	2-cycle
A. Gulowsen A. S.	Christiana	Grei	2-cycle
A/S/T De Forenede Motofabrik.	Bergen	Hein	4-cycle
A/S Kampens Mek Verksted.	Christiana	Kampens	2-cycle
Levahn Motor Co.	Christiana	Levahn	2-cycle
Bernh Oye's Maskinforretning.	Eskilstuna	Munktells	2-cycle
A/S Sondenfjeldske Motor & Mek Verkstad.	Christiana	Norsk Vestkysten	2-cycle
A/S Motoren Populaer.	Haugesund	Populaer	2-cycle
A/S Motoren Rap.	Christiana	Rap	2-cycle
Brod Christensen Mek Verksted.	Christiana	Stabil	2-cycle
Sleipner Motorfabrik.	Fredrikstad	Sleipner	2-cycle
Norsks Motor A/S.	N. Bergen	Norma	2-cycle
JAPAN			
Nijata Iron Works.	Tokio	Ikegai	2-cycle
Kobe Hatsudoki Co.	Kobe	Kobe	2-cycle
Ikegai Iron Works.	Tokio	Nigata	2-cycle
Osaka Iron Works.	Osaka	Osaka	2-cycle
CHINA			
Hip Tung Woo Engine Wks.	Canton	Hip-Tung-Woo	2-cycle

THE GERMAN SUBMARINE U-B. 110

Writing in "The Shipyard," Mr. Geo. B. Richardson, of Swan, Hunter & Wigham Richardson, of Newcastle-on-Tyne, relates his experiences in connection with the repair of the German submarine U-B. 110, which, by the way, left Kiel for her maiden trip on June 18, 1918, and which, on July 19, was damaged by a depth-bomb from the American-built motor launch No. 263 and then rammed by H. M. destroyer, "Garry." He says that, compared with British submarines of about the same age and class, the Diesel engines of the U-B. 110 seemed more powerful for the equal space occupied. She was built by Blohm & Voss, of Hamburg, and commissioned in March, 1918.

THE MOTORSHIP "FALSTRIA"

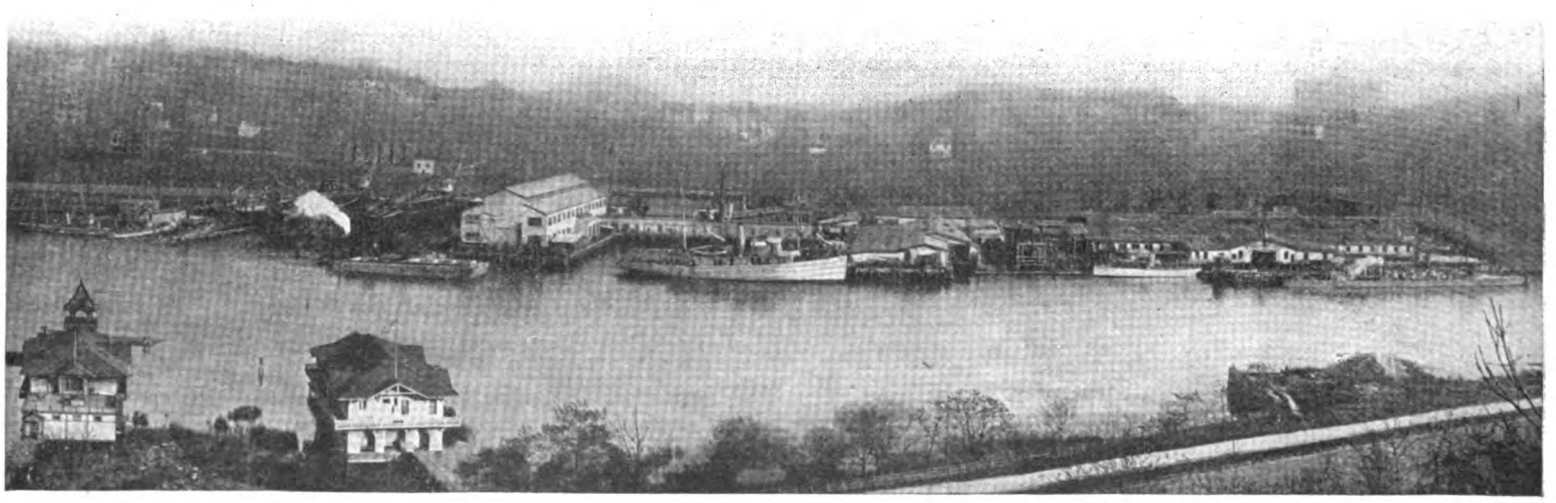
With reference to the operation of the motorship "Falstria," detailed on pages 37, 38, and 39 of our June issue, a British contemporary states that not long ago an unfortunate mishap befell her—which, by the way has nothing to do with her Diesel engine power. They say: "While on a voyage from the east coast of South America to Suez, she sustained a fracture of one of her propeller shafts, and had to put into Cape Town. Examination then showed that a new shaft was necessary, an article which it was found was unobtainable locally, owing to there being no steel of the requisite dimensions available in South Africa. The only alternative was to order a new shaft from Europe, and this was in due course manufactured on Clydeside, and shipped out to Cape Town, where it was speedily fitted by Messrs. Cunningham and Gearing, one of the local marine engineering firms. Nevertheless, the mishap compelled the 'Falstria' to spend four months of enforced idleness at Cape Town."

FIRST OF ITALY'S STANDARD MOTORSHIPS

The new motorship "Ansaldo San Giorgio I" recently arrived at the Clyde on her maiden voyage from Genoa, having averaged a speed of 11.5 knots, except during the bad weather experienced from Carthagena where she called en-route. It may be remembered that drawings of this vessel were published in our issue of April 1918, together with much preliminary information. In an early issue we intend publishing photographs and a complete description of this ship and her operation to-date. Meanwhile we will content ourselves with giving a few general dimensions and details as follows:

Dead-Weight Capacity	8100 tons
Net-Cargo Capacity (about)	7700 tons
Cross Registered Tonnage	5663 tons
Net-Registered Tonnage	3485 tons
Length (O.A)	393 ft. 1 in.
Length (B.P.)	378 ft.
Breadth (Moulded)	51 ft. 6 in.
Depth (Moulded)	30 ft. 2 in.
Draught (Loaded)	24 ft. 7 in.
Horse-power (Shaft)	2200 B.H.P.
Engine Speed	100 R.P.M.
Ship Speed (Average)	11 to 11½ knots
Type of Diesel Engine	Two-cycle
Fuel Capacity	250 Metric Tons
Cruising Radius	7150 Nautical Miles

The hull was built at the yard of the Ansaldo San Giorgio, Ltd., Muggiano, Spezia, while the Diesel engines were constructed at their Turin works. The latter are of the two-cycle type, each having four-cylinders, 24,803" bore by 35.433" stroke, and a compression of 450 lbs. per sq. inch. The engine-room auxiliaries including the Carpelli pumps and deck-winches are driven by steam at 100 lbs. working pressure. The "Ansaldo San Giorgio I" is classed with the British Corporation and with the Registro Navale Italiano.



The plant of the Consolidated Shipbuilding Co., Morris Heights, New York City. See the June issue of "Motorship"

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A Self-Adjusting Stern Tube Stuffing-Box

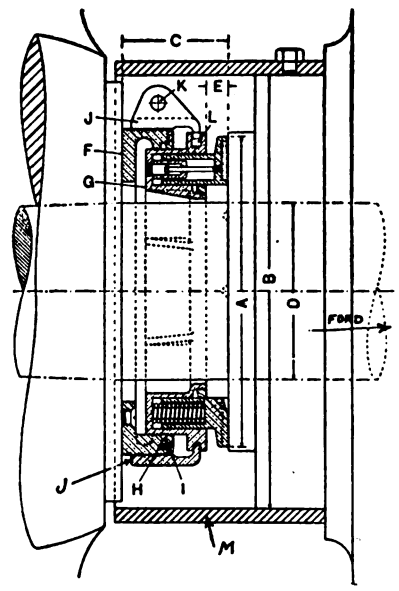
Forced Lubrication Used for the Tail-Shaft Bearings

IN many recent designs of stern-tubes stuffing-boxes and tail-shaft bearings, the attempt has been made to exclude all sea-water and lubricate both the inner and outer bearings by oil under pressure. The difficulties encountered arise from the axial movement of the propeller shaft, due principally to the elongation of the shaft caused by heating. Usually where stuffing-boxes are designed for oil lubrication, the space between the propeller boss and the stern-tube bushing is utilized to hold a compressed spring, such movement will result in a change of bearing pressure and perhaps a loss of lubricant, or even allowing sea-water to enter the stern tube.

A stuffing-box and lubricating system designed to be telescopic to a reasonable degree, yet preserve constant bearing-pressure on the gland, is the principle feature of a Swedish design produced by J. R. Cedervall & Sons, Gothenburg, Sweden. The latest device differs somewhat from their earlier designs and appears to be a decided simplification from the manufacturing point of view. So far as we are aware this device has not yet been installed on any American-built motorship, but it has been fitted to a large number of European oil-engined vessels ranging in size and type from harbor-service tugboats to the 9,600 tons d.w.c. Diesel-driven passenger and cargo vessel "Bullaren" that was described and illustrated in the January, 1919, issue of "Motorship."

The illustration showing the tail-shaft and oil-piping is a general arrangement plan of the earlier stuffing-boxes and bearings. The scheme consists essentially of mounting a telescopic or double sleeve on the shaft. The outer sleeve is independent from the inner in the direction of the shafts' axis, but is constrained to rotate with the shaft. This outer sleeve is formed into a collar faced on the forward and after-side. The after-side is pressed against a machined collar rigidly attached to the propeller post, while the forward side takes the same pressure from the machined face of a ring pressed aft from the stern-tube bushing by spiral springs and prevented from turning by dowels.

In the newer design the double bearing-surface is eliminated as described in detail as follows: Referring to the sectional plan to the left is the propeller hub and to the right is the propeller post and after end of the stern bearing bushing. The nut (J) is split in half and is bolted together by bolts (K). In assembling, this nut should be taken off the box (F) which is secured to and rotates with the propeller hub. Then the assembled gland (G) is inserted a short way into the box (F), leaving sufficient room to insert the packing (H). The packing is secured by bringing up the ring (I) and fastening it with the tap screws shown in the lower half. The distance (E) is then determined, which will give the proper compression of the springs in the telescopic gland (G), and with this position fixed the two halves of nut (J) are fitted in place by inserting the fingers into the recesses drilled at L. The halves of the nut may be revolved until they match threads on the box (F), when they may be clamped together by tightening the bolts (K). Then the single frictional surface is at the face of the stern bearing-bushing, and this may be made a machined fit. A protector plate (M), in

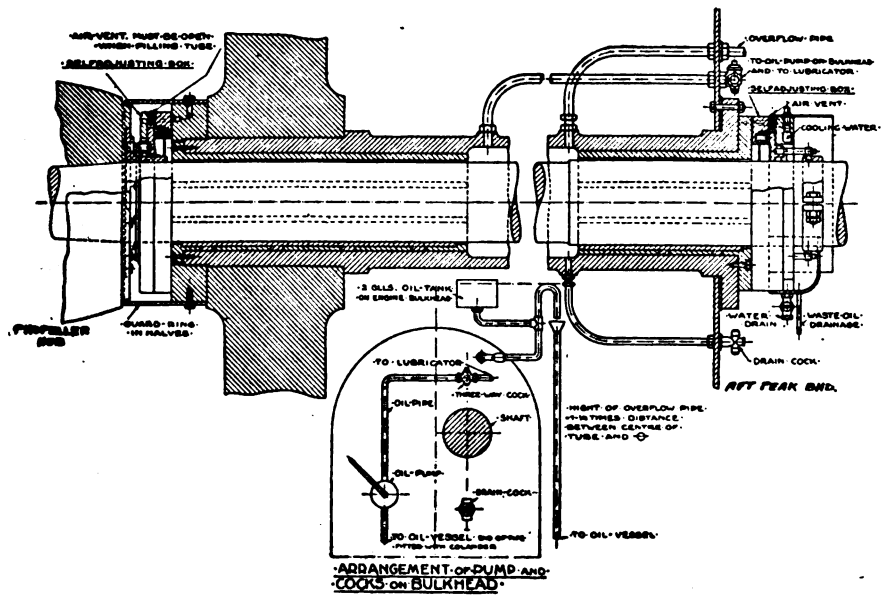


Section of a later design of Cedervall self adjusting stuffing box

halves, may be attached to the stem bearing bushing or propeller-post, as usual.

In preparing to use this type of stuffing-box the measurement (C) should be the mean of the full-contracted and expanded length of the box. This expansion for values of D equal to 92-105 m/m (3-6 in. to 5-1 in.) is 13 m/m (0.51 in.), and for shafts of 507-526 m/m (19.56 in.-20.7 in.) it is 19 m/m (or 0.75 in.).

Returning to the general arrangement plan it may be remarked that the inner and outer stuffing-boxes are practically the same. Each stuffing-box is provided with an air vent and this should be opened during the initial filling of the stern-tube with oil. The pressure supply pipe is led to the centre of the stern-tube between the forward and after end bearings. From a height of 25% greater than the head of water over the stern-tube due to the draft, an overflow and supply tank should be located. This will provide an excess of pressure inside the tube when the vessel is not underway and prevent sea-water from entering. When underway a higher pressure is provided by a pump to maintain efficient lubrication at the bearings. These, it is claimed, may be made a closer fit than in the old system of lignum vitae and water lubricated bearing. Undoubtedly particular benefit might be derived from an efficient stern-tube stuffing-box and bearing where much work is done in sandy or shallow waters.



Cedervall stern-tube fitted with stuffing boxes for oil lubrication

MOTORSHIP FOR THE SVENSK Ø. K.

A steel motorship of 5,640 tons, d. w. c. is under construction for the Svensk Ø. K. of Gothenburg, Sweden at the Burmeister & Wain shipyard, Copenhagen. Two 6-cylinder 630 mm. by 960 mm. Diesel engines will be installed, which together will develop 3100 I.H.P. The yard number of this ship is 315 and she has the following dimensions:—

Length	425' 5½"
Breadth	55' 0"
Depth	38' 6"

She is being built to Lloyd's highest class and will soon be placed in service.

ERRATUM

Pressure-Volume Diagram for Heat Cycles

The figure illustrated herewith was unfortunately omitted from the June issue. In the last column on page 46 in the discussion of "Heat

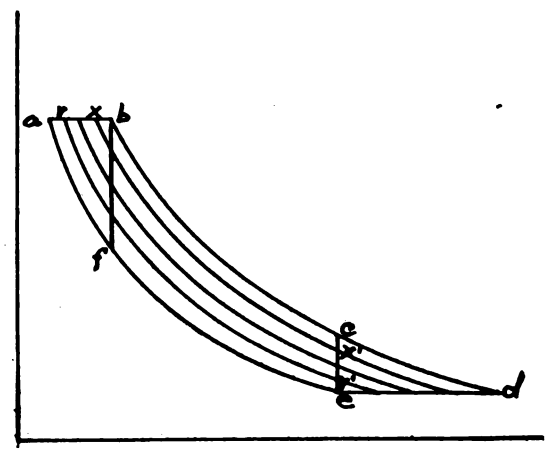


Fig. III.

Cycles" by R. D. Karr, reference is made to the P.V. diagram as sketched in Fig. III. Continuing the reference thereto the description as originally published should be corrected to read as follows:

". . . that particle of heat added from a to r which can be" . . . etc.

The last line on page 46 should read:

"that from r' to c, the useful work represented."

SHIPPING BOARD TO CONVERT STEAMERS TO MOTOR POWER

According to a statement in a British shipping weekly, the U. S. Shipping Board have decided to fit the steamers "West Mohammed;" "Westport;" "West Tyscal;" and "Verona" with Diesel engines. The two first-named are already at sea with steam-engines, those of the "Westport" being triple expansion and the "West Mohammed" turbines. In the interest of our country, we hope that our contemporary's statement is founded on fact.

RACE BETWEEN AUXILIARIES AND SAILING-VESSELS

We understand that a novel long-distance race is now taking place between two motor-auxiliary schooners and two sailing-vessels that have no auxiliary power. The auxiliary vessels in question are the "Mount Hood" and "Mount Shasta," while the sailing-vessels are the "Mount Whitney" and "Mount Hamilton." All these vessels are of about 2,400 tons deadweight capacity and each will carry approximately 1,500,000 feet of lumber as cargo. The race is between Seattle and Norway, and the ships are owned by Mons. Isacksen and Cornelius Bull of Christiania, Norway, respectively and are American built and engined.

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Power Development in Diesel Engines

Notes on the Diversity of Available Designs

(Contributed)

[We do not necessarily endorse all or any of the opinions expressed.—Editor.]

IT is not the aim of this article to present adverse criticism on the progress made by internal-combustion engines especialy in relation to marine engines. It is nevertheless a fact that unless some decided advancement is made speedily the present opportunity of firmly establishing the internal-combustion engine, as the most reliable and efficient means of propulsion for *all* classes of vessels, will be lost.

This opportunity exists through the necessity of replacing the large amount of shipping lost during the war. Many of these vessels were of small tonnage, but all these and more must be built if we are to successfully compete in the trade war. Now where does the Diesel engine vessel stand in this emergency? Every day it becomes more and more recognized as the most efficient engine for medium-powered vessels, and the power installed in new vessels is steadily increasing until in the m. s. "Glenapp" two engines each of 3,300 indicated horse-power in 16 cylinders have been installed.

There is no doubt that this steady increase can be maintained, but this is not sufficient; for before any hope of a Diesel installation being supplied for higher powered liners and similar vessels can be entertained, there must be a development from engines of three thousand horse-power, to say twenty thousand horse-power. Thus there is a great gulf fixed between the existing engines and those which may be called the present ideal. Perhaps Doxford & Co. are making the greatest step, as their engines are designed to develop 3,000 h.p. from four-cylinders at 70 R.P.M. With 16 cylinders this means 12,000 H.P. per ship.

It is necessary, therefore, that some method of increasing or of concentrating the available power be devised. There seem at first glance to be several ways open to new enterprise, and it is the purpose of this paper to briefly study the following:

(1) Increase in engine dimensions.
(2) Double-acting engines.
(3) Opposed piston engines.
(4) Conservation of power.
(5) Turbine.

Considering the first of these ideas, we at once realize the difficulties underlying the problem, for although this would seem to be on the lines of natural advancement, we find that to effect any appreciable increase in the power a large increase must be made to either the bore, stroke or mean-pressure. There is a limit, however, to the amount the bore can be increased, for as the bore is increased, the temperature stresses in the walls of the combustion-space becomes more serious, due to increased thickness of the walls, and the fact that one side of the walls are in direct connection with the hot gases, while the other side is in connection with the cooling one, creating a large range of temperature. These temperature stresses are not calculable, but they are known to be extremely high. Again, as the area of the piston is increased the total pressure to be dealt with becomes enormous and unwieldly.

With reference to increasing the stroke in relation to the bore, it must be noted that the present piston speed of a Diesel marine engine is often in the neighborhood of 1,000 ft. per min. (and in submarine engines, 1,500 ft. per min.), which is a much higher figure than in steam practice. The increase in power in this direction therefore is negligible. Increase in cylinder pressures brings us back to the trouble of thick walls as in the case of large bores, so we are forced to look in another direction, the most obvious of which is the

Double-Acting Engine

This design seems to offer greater hopes, for with a very slight increase in the overall sizes of the engine we seem able to nearly double the power obtainable in the cylinder. Now the largest single-cylinder engine of the single-acting type has been capable of developing 1,000 B.H.P. There are one or two such engines, as for instance the one constructed by Messrs. Vickers, Ltd. These engines are at present purely experimental, as the largest sizes in practical operation develop not more than two-thirds of this power per cylinder.

Assuming, however, the practical utility of such an engine being established, a six-cylinder engine would seem to be about the logical size to construct. Thus a triple-screw vessel having three such engines would have a total B.H.P. of 18,000, whereas the same vessel with double-acting engines would have 36,000 B.H.P. The difficulties to be overcome are by no means insurmountable, and expert attention is being paid to the problem by various firms. The principle is naturally more suitable for application to engines of the two-cycle port-scavenging systems, which requires only one working valve per cylinder than to four-cycle or two-cycle valve-scavenging engines.

The stuffing box is an awkward feature in this design, but this is practically solved now, as is also the type of piston construction which must allow for expansion. Naturally the height of a double-acting engine is higher; but as height is not of primary importance this does not affect the problem at all. The double-acting engine

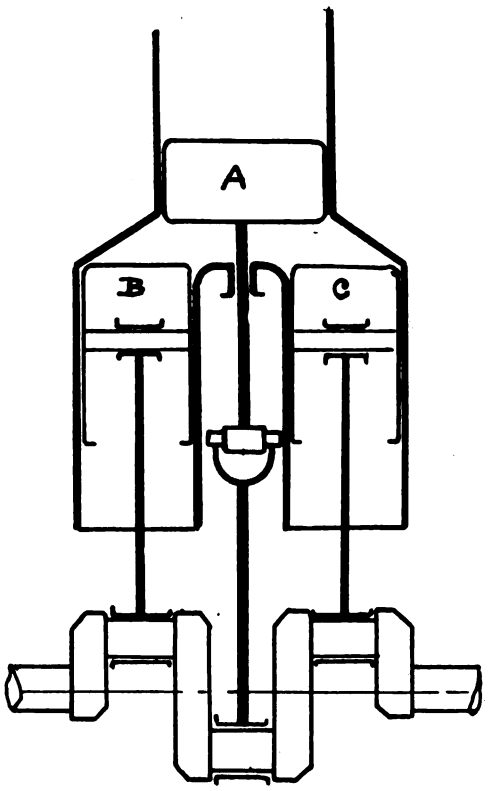

Diagram of experimental design of Diesel engine built by Vickers, Ltd.

has several other advantages, as for instance the fact that the lubrication of the bearings is greatly helped, due to the alternate lift and pressure on the shaft. [There are a number of designs not yet perfected for types of double-acting engines without glands and stuffing boxes, such as the White, Van Hogendyk, Lisle, and Verhey. All these offer considerable promise but mean not a little expense and time if they are developed.—Editor.] Leaving the double-acting engine we can turn our attention to the type of

Opposed-Piston Engine

and its allied types. This type of engine has many of the advantages of the double-acting engine, without some of its drawbacks. As constructed in its ordinary form it is well known. Its chief advantages are that the necessity for a cylinder-cover is at once removed, while for each pair of pistons there is only one valve of each type, and as port-scavenging is usually adopted, if not altogether, it follows that there will be only one fuel injection, and one starting-valve in each cylinder. As in the double-acting engine twice the power, is obtained for the same cylinder bore as in a single-acting engine, only in this case two pistons and three connecting-rods are necessary, thus to a large extent counteracting the advantages obtained.

Following on this, the well-known Junker design is interesting, as four pistons instead of two comprise one unit. True, a large increase in the height is effected, but as height is of comparatively small importance in a vessel as compared to any saving in the length of the engine, this is of small account. Therefore if the mechanical difficulties attendent on this design could be overcome, there is no doubt that this type of engine would be able to enter the field in competition against even the highest powered steam ships.

Another design of interest in passing, but which does not lend itself to any solution of the problem is that shown in Fig. 1. This design was, we believe, adapted for experimental work by Messrs. Vickers, Ltd., and constructed for them at the Dudbridge Iron Works. As will be seen from the illustration, there are three pistons open to the same combustion space, and one of these, the centre one (A) is larger than the other two and is mounted on a piston rod, which being in the combustion space, has to be supplied with a stuffing box. The two outer pistons B. and C. are smaller in diameter than the centre one. The total area of these two pistons being equal to that of the centre one, the crank-shaft is a triple one, there being one conn-rod for each piston. This design we believe was not very successful, owing, presumably, to the awkward shape of the combustion space. Vickers have not attempted to place this engine on the market.

Of the opposed piston engines there are still two, one of which mention has not been made, viz., Doxford and Fullager engines. The Doxford engine is well-known, and as it is practically of the opposed piston type already described, further description is unnecessary.

The Camellaird-Fullager Engine

however, is not so well known. Some few years ago Mr. Fullager brought out a design for a gas engine on this principle, and one such engine was erected and is still working satisfactorily, as was described and illustrated in one of the 1918 issues of "Motorship." It will be remembered that each unit consists of two cylinders, in each of which there are two pistons. The special feature of this design is that the top piston in each cylinder is directly connected to the lower piston in the other cylinder by long tension rods bolting in the crossheads. Thus the negative forces on each piston are directly balanced by the positive forces on its connected piston, thereby reducing all the stresses in the framing to a minimum. The method of connecting the pistons in two cylinders enables the centres to be kept close, and thus reduces the overall size. Shortly after the commencement of the war Messrs. Cammell-Laird & Co. undertook the problem of converting the Fullager gas engine design into a Diesel oil engine. Judging by the announcements which have recently made their appearance, this firm seems to have been successful in their aims. To quote the same they claim their engine to possess, among other advantages, the following:

(A) 50% more power in same space over other engines.

(B) Even turning moment and perfect balance.

(C) No vibration. Simple, silent and reliable.

If these claims can be substantiated in practice it would seem as if this engine would go far towards the increasing of Diesel engine power. The results of the Cammell-Laird welded motorship which is to be equipped with one of these engines will be noted with interest.

The next point to be considered is that called the

Conservation of Power

By this we mean the saving of unnecessary power used for auxiliary purposes. This method does not present much chance of success, as the size and power required for driving fuel and lubricating pumps, etc., has been cut down to a minimum as the results of long experience of Diesel engine requirements. There is, however, one point already much debated, but which we are certain offers encouragement to enterprise. We refer to the adoption of a solid-injection system of fuel injection. Using this system in place of the usual air-injection system effects a saving in engine power of 10 or 11 per cent.

The economy of the motorship over the steam ship is large enough to justify the sacrifice of a small amount of fuel, in order to assist the installation of high-powered motors. This point of view is very largely a matter of suggestion, but so long as there is the remotest possibility of it

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having any success, so long should it be counted on. For instance, suppose we take the Fullager engine, and taking the manufacturer's claim of being able to supply 50% more power in the same space than in other engines, we get that an engine the size of one of those of the "Glenapp" would develop at least 4,950 horse-power, and this if fitted with solid-injection should develop another 500 horse-power, making a total of practically 5.500 horse-power, although, perhaps, with a very slightly higher fuel consumption per B.H.P. hour. Working on this assumption we find that a solid-injection Fullager engine of similar dimensions to those of the largest existing marine Diesel would develop approximately 66% more power. This is without question a point worthy of consideration. To discuss our last point, the

Internal Combustion Turbine

seems to be rather like dealing with the abstract. It was, however, only the successful design of the steam turbine which made it possible for vessels like the "Mauretania," the "Olympic" and other such vessels to be built, and similarly the successful design of an oil turbine perhaps may be the final solution to oil-engine development for similar vessels. One or two gas turbines have been certainly constructed, but up to the present no marketable engine has been produced. Private enterprise long ago entered the field, and we hear from time to time of designers who are undertaking experimental work in this direction, and although the difficulties to be overcome are many and great, it is only reasonable to believe that sooner or later the problem will be satisfactorily solved.

It seems improbable, however, that the pressure will be continuous, but rather that it will be necessary to deliver it in a series of gusts following quickly upon each other from different points of turbine end. This will produce an even running machine without having a continuous flow of pressure. The greatest difficulty to be faced is to obtain the necessary compression for combustion purposes. To conclude, it would seem that if we are to become more than the tail end of the main engine industry we must not hesitate to change our ideas or to support even freak designs which offer any promise whatever. Above all, it should not be forgotten that the turbine will carry all before it if once a marketable, economical and reliable design is produced.

Interesting News and Notes from Everywhere

INDIAN PASSENGER MOTOR-LAUNCH

A 64 ft. passenger motor-launch fitted with an American gasolene motor has been built at Calcutta by Pyne Hughman & Co. Ltd. The engine is a Regal of 28 b.h.p.

ADDRESS WANTED

Will Mr. H. Akroyd Stuart, of Western Australia, kindly forward to this office his present address, as his letter of January 25, 1919, has no address on the same.

DUTCH MOTOR-VESSEL, "EUROPA"

In the 145 tons-gross steel motor-vessel, "Europa," built in 1918 by J. J. Bodewes of Pannerden, Holland, a Kromhout surface-ignition oil-engine has been installed. This vessel is owned by the Vracht Mij Neerlandia, of Rotterdam.

SHIPPING, ENGINEERING & MACHINERY EXHIBITION

An important exhibition in connection with the above industries will be held at the Olympia, London, England from Sept. 25th to Oct. 15th of this year. It is expected that many marine heavy-oil engine builders will exhibit. We suggest that American oil-engine builders exhibit if possible.

RAFT "SHIP" WITH AUXILIARY OIL ENGINES

A lumber raft 250 ft. long by 60 ft. breadth and 30 ft. depth is to be built in British Columbia by Vickers Ltd. for one voyage to England via the Panama Canal. There will be about 5,000,000 feet of timber. As auxiliary power to the sails two heavy oil engines will be installed. This will be the first really "unsinkable" motorship.

A SHIPBUILDING COMPANY'S OPINION OF MOTORSHIPS

Burmeister & Wain, the Danish shipbuilders, say they are convinced that the motorship will be the type of vessel which in future will be employed to trade on long voyages, and they are satisfied that neither steam reciprocating-engines or steam turbines will be able to compete. They say that inquiries for motorships and Diesel engines are increasing every day.

CONCRETE MOTORSHIP "ODDFRID"

The 750 tons d.w.c. concrete motorship "Oddfrid" has been completed at Moss, Norway for the Damspskibakties Odd of Christiania. Two Bolinder surface-ignition oil-engines are installed at the same yard, namely the Fougners Concrete Shipbuilding Co. The concrete motorvessel "Patent" also has been launched at this yard. She is 141 ft. long and of 455 tons d.w.c. and also is propelled by Bolinder oil-engines.

SWEDISH MOTORSHIP "STUREHOLM" LAUNCHED

Building to the order of the Swedish America-Mexico Line the twin-scew motorship "Stureholm", 7,750 tons dwc. was launched on May 8th, and is the seventh large Diesel-engine vessel launched at the Gotaverken (Gota Shipyard) Gothenburg.

Her dimensions are as follows:

Length	412 ft.
Breadth	53 ft.
Depth	26 ft.
Draught, loaded	23 ft.
Cargo hatches	5, each 24 ft. x 9 ft.
Power	2600 I.H.P.
Engine speed	150 R.P.M.
Ship's speed	10¾ knots
Classification	Lloyd's 100 A. I.

She is fitted with two six-cylinder 1300 I.H.P. Burmeister & Wain type Diesel oil-engine constructed by the builders of the hull under license, and is a sister vessel to the motorship "Skajein", recently launched at the same yard for the Transatlantic Company of Stockholm.

CHANGE OF ADDRESS

The Columbian Bronze Corporation announces the removal of their local New York City Showrooms from Concourse, 50 Church Street, to the more central location of 44 Third Avenue, between Ninth and Tenth Streets, one block east of Wanamaker's.

GERMAN MINESWEEPERS NOW CARGO MOTORVESSELS

Danish shipowners are being offered a number of Diesel-driven motorships of 600 to 800 tons d.w.c. These craft were designed as 168 ft. mine-sweepers, but are being finished as passenger and cargo vessels in Germany.

READERS MISSING COPIES

Four copies of our June issue have been returned by the Post Office owing to the address labels having become detached. Therefore, if any readers who do not receive their June copy will communicate with us, we will send a duplicate copy.

AUGUST 1918 ISSUES NEEDED

The publishers of "Motorship," 44 Whitehall Street, New York City are in the market for about 20 copies of "Motorship" for August, 1918, and are willing to pay 50c each for them.

CARGO CARRYING CAPACITIES OF MOTORSHIPS

Although the Italian motorship "Ansaldo San Giorgio I" is of but 8,100 tons d.w.c. and 5,663 tons gross, she carried no fewer than 7,600 tons of iron-ore on her maiden voyage. Compare this net-cargo capacity with the actual cargo-capacity of a steamship of similar d.w.c. It will show how misleading is the term "cost per ton D.W.C." when purchasing a motorvessel.

FAST COASTAL MOTORBOATS

Some of the fast coastal motorboats built by John I.Thornycroft & Co. for the British Admiralty were 70 ft. long by 15 ft. breadth, and of 750 b.h.p. A speed of 30 knots was attained with two torpedoes on deck. The Admiralty will continue to carry on experiments with these little motor torpedo-boats and in at least one of the 70 footers two 24 cylinder 750 b.h.p. Thornycroft gasolene engines will be installed. With 1,500 b.h.p. at about 1,400 r.p.m. at least 50 knots should be obtained as the hulls are of the hydroplane type.

UNDERWRITERS AND MOTOR-VESSELS.

(From a British Correspondent)

There would appear to be a swing of the pendulum in favour of motorships, as underwriters are being offered insurance on such vessels up to 10,000 tons, to a far greater extent than before. In the early days of the motorship development, some British shipowners did not have the best luck with the bigger vessels, so that this new activity is interesting, as it denotes the increasing confidence in motorships caused by the splendid reliability of the modern Diesel-driven merchant ship.

MOTOR TANKER FOR ANGLO-AMERICAN OIL CO.

Two six-cylinder Vickers solid-injection type marine Diesel engines of 1,250 shaft H. P. each are under construction for a tanker now building in England for the Anglo-American Oil Company. In the place of the usual Vickers cast-iron columns, the forged steel system of construction is being followed in order to save weight. Forged steel columns were also used with the two Vickers Diesel engines of the "Santa Margherita," whereas cast-iron columns were used on other Vickers motor tankship engines.

M.S. "CHRISTIAN X" NOW NAMED "FRATELLI BANDIERA"

In 1912 the Danish East Asiatic Company's new motorship "Fionia" was purchased by the Hamburg American Line at the request of the ex-Kaiser and named "Christian X." During the war she was taken-over by the Italian State Railways and re-named "Fratelli Bandiera." She is of about 7,000 tons d.w.c.

TRADE BETWEEN HOLLAND AND AMERICA

The Commercial Department of the Royal Netherland Legation at Washington, D. C. has recently been established for the express purpose of fostering trade between the United States and Holland, and is in a position to give commercial information about trade between the two countries to American merchants. Communications should be adressed to the Commercial Attaché.

DIESEL ENGINES FOR THE SUBMARINE BOAT CORPORATION

An order for a 2,500 shaft H.P. six-cylinder 30" bore by 48" stroke reversible four-cycle marine Diesel-type engine has been placed with the James Craig Engine & Machine Works of Jersey City, by the Submarine Boat Corporation who also have placed on order for an engine of a little less power with the New London Ship & Engine Co. of Groton, Conn. The Craig Engine in many ways will resemble the designs of his smaller Diesel engines, of which 18 are already in service.

BRITISH-BUILT MOTOR LIFEBOATS FOR ITALIAN SHIPOWNERS

Our contemporary the Liverpool "Journal of Commerce" announces that an Italian firm of shipowners has placed an order with Wm. Hill & Co. of Corstorphine Town, South Shields, England for two 60 ft. motor-lifeboats to be carried aboard ocean-going ships. These boats will be provided with "sound-proof" cabins, and fitted with very powerful engines. They will be able to accommodate 74 persons, and each is built to tow ten ordinary ships' lifeboats, each of which will carry ten persons. The motor-craft will be fitted with wireless apparatus, so that their effectiveness to render aid extends over a very wide radius.

GENEROUS GIFTS

Mr. H. W. A. Deterding, a director of the Anglo Saxon Petroleum Co. and the head of the Royal Dutch-Shell oil combination, has personally given $50,000.00 toward the fund of two-hundred guineas donated to endow a chemical school at Cambridge University, England, sums of $250,000.00 each have been contributed by the Burmah Oil Co., Anglo Persian Oil Co. and the Anglo Saxon Oil Co. Lord Cowdray and the Hon. Clive Pearson also have given $250,000.00 each. These gentlemen and the respective companies are users of motor-ships and are strong believers in the marine heavy oil-engine.

SHELL COMPANY INCREASE CAPITAL

The "Shell" Transport & Trading Co., of London, the great oil-company associated with the Royal Dutch Petroleum Co., has increased its capital to $125,000,000.00. At the meeting held at the end of April, Sir Marcus Samuel stated that the Company's production in almost every field in which they were operating showed substantial and gratifying growth, and they alone, among all oil companies, were able to furnish from their own productions supplies at centers so wide apart as Mexico and Egypt, Borneo, and California. The production of oil in Borneo was at the present moment the largest in the history of the Company, and this was of great importance, seeing its adjacency to India and the peculiar adaptability of the kerosene produced from the crude-oil for the Indian market.

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Piston and Valve Cooling in Diesel Engines

Problems That Arise and Examples of Designs Now in Use

(Contributed)

PERHAPS the most difficult problem which confronts the designer of high-powered Diesel engines is that of piston design. When we consider the very severe conditions to which this unit of the mechanism is subjected, the difficulties will be readily appreciated. Upon analyzing the functions of the piston of an internal-combustion engine, we find that in the first place its top surface forms one wall of the combustion-chamber, and is consequently subjected to temperatures of about 3,000 degs. Fahr. Secondly, it must be gas tight in order to prevent the escape of high-pressure gases; thirdly, it has to transmit the load from the expanding gasses to the connecting-rod, and lastly in the case of trunk pistons it must be subject to the lateral thrust due to the obliquity of the connecting-rod, and so must be of sufficient length to keep the

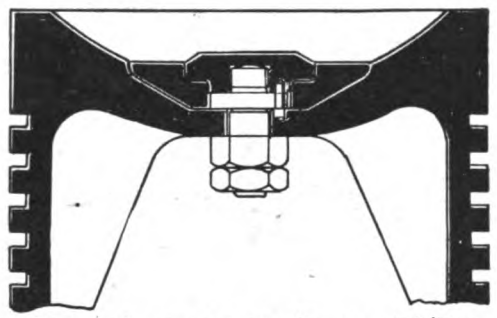

Fig. 1

bearing pressure due to this thrust within a reasonable figure.

The severe conditions imposed by the combined duties arising from these different functions necessitate a strong and substantial design, but at the same time it is essential to keep the piston as light as possible in order to reduce the inertia forces and incidently the stresses in the connecting-rod, bottom-end bolts and bearing-caps. Undoubtedly the most serious difficulties encountered are due to heat stresses in the crown of the piston, and to this cause must be attributed the majority of cracked pistons, which were of such frequent occurrence in many of the pioneer types of Diesel engines, but which in most modern designs are rare occurrences.

The heat stresses naturally are considerably higher in the two-cycle engine than in the four-cycle, as in the former type combustion takes place at each stroke of the piston, whereas in the latter type of engine the idle strokes give a longer period for the transfer of heat from the piston to the cooling medium, and consequently the mean-temperatures are considerably lower, which accounts for the greater average reliability of this type of engine in the past. It is admitted that the failure of some designs of two-cycle engines has been due to the severe heat conditions in the combustion chamber, and in my opinion it is doubtful whether the difficulty will be overcome with the materials at present at designers' disposal.

[Perhaps builders of two-cycle type Diesel engines will reply to this contention, as we believe their experiences differ from the above.—*Editor.*]

While investigations have been carried out at various times in order to determine the stresses produced by the heat-flow set up in the combustion-chamber of oil-engines, it appears that owing to difficulties and complications encountered no results can be claimed which are of any assistance to the designer in proportioning his designs, which are consequently based on personal judgment and previous experience.

The tendency in Diesel engine piston design is to make the crown considerably thicker than the mere explosion-pressure warrants, since the temperature range will be more gradual than in the case of a thin plate which is perhaps red hot on one side and comparatively cold on the other. In this case it will readily be seen that the material will be very much expanded on top and very slightly below, giving rise to enormous internal stresses. The dangerous section of the piston is undoubtedly close to the junction between the cylindrical walls and the crown, as a liberal fillet is usually allowed here, and consequently we have a mass of metal containing a large quantity of heat connected to a considerably thinner ring which is subject to the cooling action of the cylinder walls, and therefore at a much lower temperature. Any sharp corners should be rigorously avoided in the piston-head, as the structure of the metal is always weak in such cases. Piston crowns are usually fitted with ribs on the underside, which are perhaps more intended to conduct away the heat than to add strength.

In four-stroke-cycle engines pistons can be safely run up to 15 inches diameter without recourse to cooling, but above that size I consider some method of cooling should be adopted. In two-cycle engines the limiting size is smaller owing to the more severe conditions encountered, and in my opinion it is not wise to run two-cycle engine pistons above 9 inches without cooling. [The running speed of the engine has much to say in connection with the diameter and cooling question.—*Editor.*]

Small pistons which are not cooled are very often fitted with a plug of nickel or other heat resisting metal in the centre, as shown in Fig. 1. It is claimed that with this system expansion stresses are reduced. Another method which has been successfully adopted to avoid defective pistons is to construct the piston in two portions as shown in Fig. 2. The upper portion is carefully bedded on to the lower portion, and the two secured together by studs. This method has the advantage that different qualities of metal can be used for each portion. The lower section, which has of course to carry the load due to the obliquity of the connecting rod is made of a very hard quality of iron while the upper portion can be made of a quality more suitable for resisting the heat stresses. Moreover, if the upper portion does develop a crack, it can be more cheaply replaced than if the whole piston had to be scrapped. The initial cost is of course higher, but it may be emphasized here that it is not good policy to sacrifice quality for cheapness when constructing Diesel engines, as a little care and trouble taken by the builder will repay itself in the long run.

The use of copper-aluminum alloys could be

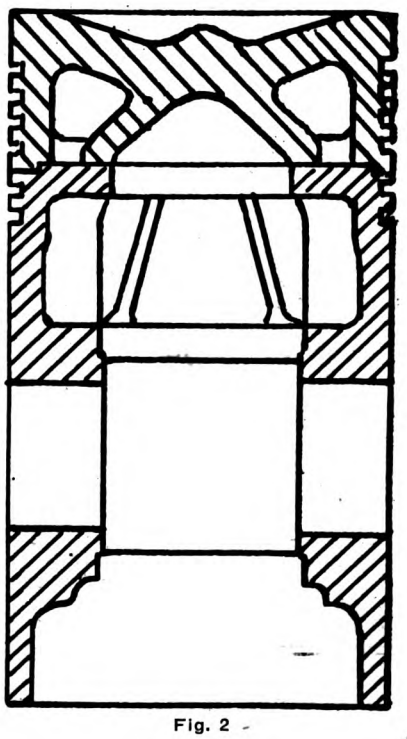

Fig. 2

made more use of in smaller sized pistons for Diesel engines than has been done. This material has a conductivity about four times that of cast-iron, and is considerably lighter, which in themselves constitute big advantages. The writer has run multicylinder Diesel engines with aluminum pistons up to 14½ in. diameter, with considerable success.

There are three mediums employed for piston-cooling, air, oil and water; the first is not very effective, and has only been used in a few isolated cases, the most notable, perhaps, being in the Werkspoor engined motorship, "Vulcanus," one of the first successful Diesel-driven vessels. In this case a centrifugal fan delivered air under low pressure into a number of telescopic tubes which directed the flow of air into the crown of the piston, whence it escaped into the engine-room. Needless to say the cooling effect is somewhat superior to that caused by the air currents derived from the motion of the piston itself. The cylinder diameter of the "Vulcanus" engine is 15¾ in. and above this size Werkspoor always use sea-water cooling for the pistons.

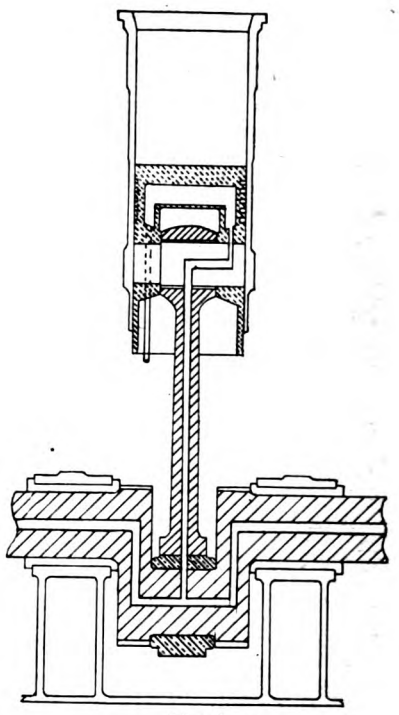

Fig. 3

In regard to oil and water cooling of pistons, both systems have their advantages and drawbacks, which we will now proceed to discuss. The methods adopted for delivering the cooling liquid to the piston head can be divided into two methods, namely, "telescopic pipes" and "walking tubes," but there are almost as many variations of both systems as there are engines, the fundamental principles underlying the various designs being the same. The problem of cooling trunk-pistons presents many more difficulties than that of cooling short pistons such as are used in conjunction with piston-rods and cross-heads.

The method usually employed on trunk pistons is shown in Fig. 3, where the same oil is used for cooling the piston and lubricating the bearings. The oil passes in the usual manner through the crankshaft and connecting rod to the gudgeon pin, whence it passes through a passage drilled, or cast, in the piston-wall to the crown, escaping through a similar passage back to the crankcase. This method is simple and cheap. That is the only claim that can be made for it. In the writer's opinion it should never be used, as the oil coming into contact with the hot piston-crown very soon loses its lubricating properties, and consequently the bearings suffer. Moreover, some of the oil sticks on the surface of the piston until it is gradually carbonized by the heat, when small particles of hard grit are carried back to the sump, which find their way past the strainers and into the bearings. The consumption of lubricating oil is also very heavy with this system. Oil coolers of ample size must also be provided.

But a modification of this system is employed on the latest M. A. N. (Augsburg) submarine engines, which has some good points. The oil is delivered by a pump driven from the crankshaft to each piston through what are usually termed "walking pipes," details of which will be given further on; after circulating around the piston-head the oil is delivered by the second "walking pipe" into a funnel, so that it can be seen at once

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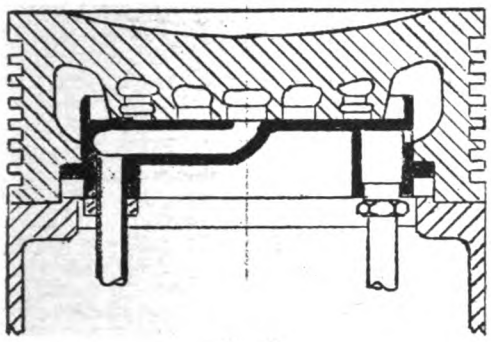

Fig. 4

whether there is any stoppage in the system, and also the temperature can be tried at regular intervals. From the funnel the oil flows by gravity back to the sump tank and coolers, whence the pump circulates it again through the system, which is quite separate from the lubricating oil circuit.

The advantage of this system lies in the fact that a lower quality of oil can be used for piston cooling, and the bearing lubricating-oil is unaffected and consequently lasts longer and lessens the danger of bearing trouble. Any oil which leaks from the joints of the "walking pipes" will not have much effect on the lubricating-oil, as would be the case if water was used and if leakage took place, which to a certain extent is bound to happen at times.

Oil-cooled pistons are also used in the Franco-Tosi submarine Diesel engines, a section through a trunk piston being shown in Fig. 4. The ribs are in the form of a spiral, the oil entering at the centre and being compelled to travel round the passages formed by the spiral guide before it can escape at the side. This ensures the oil passing over the whole surface of the piston crown, no air locks or pockets being possible.

Messrs. Burmeister & Wain adopted oil-cooling on the Diesel engines of some of their earlier merchant vessels, but have now abandoned it for sea-water. Except for submarine engines, where circumstances are exceptional, oil cooling is seldom adopted in modern practice, although one or more American designers are using it.

In regard to the slow speed heavy marine Diesel engines, which nowadays are practically always constructed with crossheads and guides, it is best to adopt water-cooling on account of the lower working costs. Several methods of delivering the cooling-water to the pistons have been devised. The point to consider first is that of leakage; any salt-water dripping down into the lubricating-oil very soon renders it useless, with disastrous results to the bearings and bottom ends. Several of the earlier high-powered installations have had serious trouble through this cause, necessitating an entire change of system at great expense. In one case a set of two-cycle engines were removed from a ship altogether, and four-cycle engines of another make installed, the failure of the first set being blamed entirely on the piston-cooling service.

Probably the most extensively used system is that of telescopic-pipes, the simplest arrangement of which is shown in Fig. 5. Attached to the piston are two pipes which pass through the glands shown into two stationary pipes attached rigidly to the engine framework; the water is delivered to one of the fixed pipes, from which it passes through the telescopic-pipe to the piston and out again by the other. The difficulty is to maintain correct alignment between the tubes under ordinary sea-going conditions, so that excessive wear does not take place and water leak past the glands, which are impossible to keep tight or to accurately line up after once removing for inspection, etc., and the tube breaks at the neck.

To render the said tubes self-aligning is the aim of the designer; one very ingenious method has been designed by J. O. Jorgensen and adopted on some of the Burmeister & Wain engines. The device is shown in Fig. 6. The piston is attached to the piston-rod flange at the top. Below this is fitted a plate (A), making a watertight joint with the piston itself and also the piston-rod. Attached to the boss (B) are the pipes (C-D). The casting (E) is attached to the

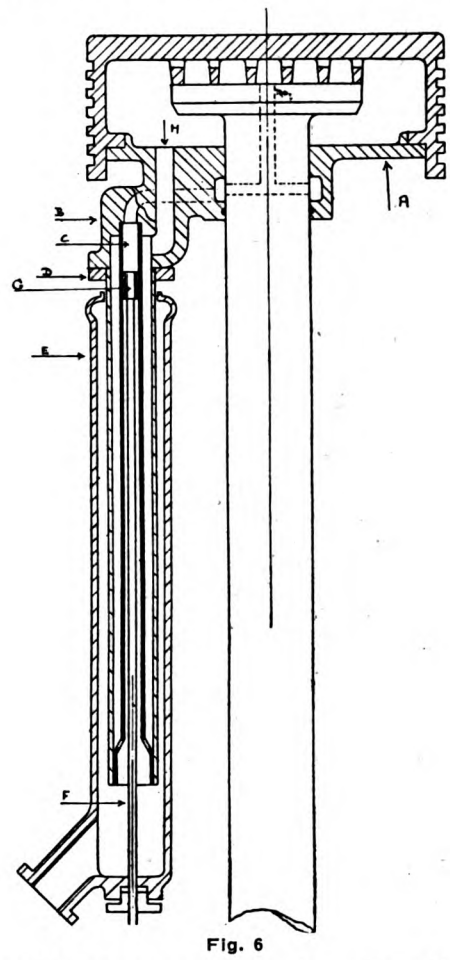

Fig. 6

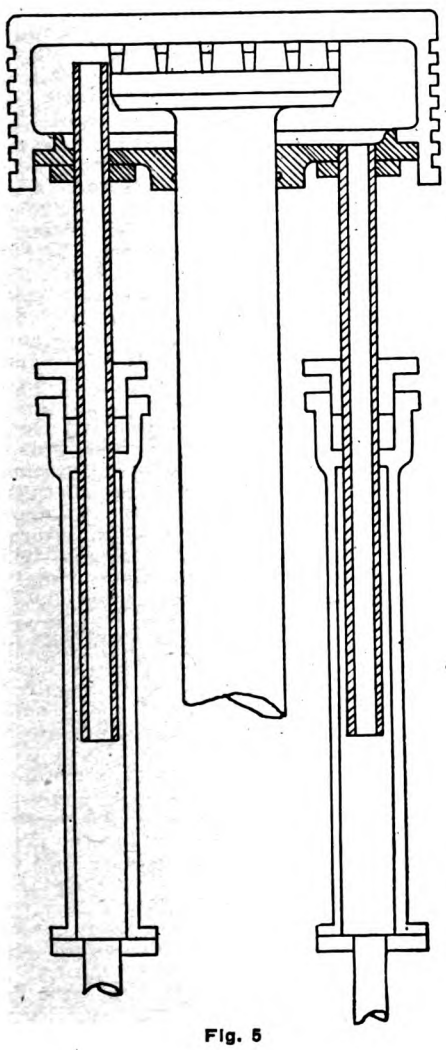

Fig. 5

engine-bed, and carries the pipe (F), which is fitted with a bush (G) that is an easy fit in the pipe (C); the pipes (C and D) being both fixed to the piston, the telescopic action is only between the pipes (C and F), and as the latter is comparatively flexible any slight mis-alignment is negligible.

It will be noticed that there are no glands to give trouble or to cause fractures in the pipes. The water passes up through the tube (F) into the tube (C), whence it flows through the passage drilled in the piston-rod, to the crown of the piston, thence it escapes through the passage (H) into the pipe (D) and out to the discharge casing (E). Any water leaking past the bush (G) merely goes into the discharge pipe. As the area of the casing (E) is large in comparison to the volume of the discharge water, there is no chance of the water overflowing past the top. This system has proved very effective and reliable in service.

Another excellent system which has been successfully employed on the Werkspoor engine is

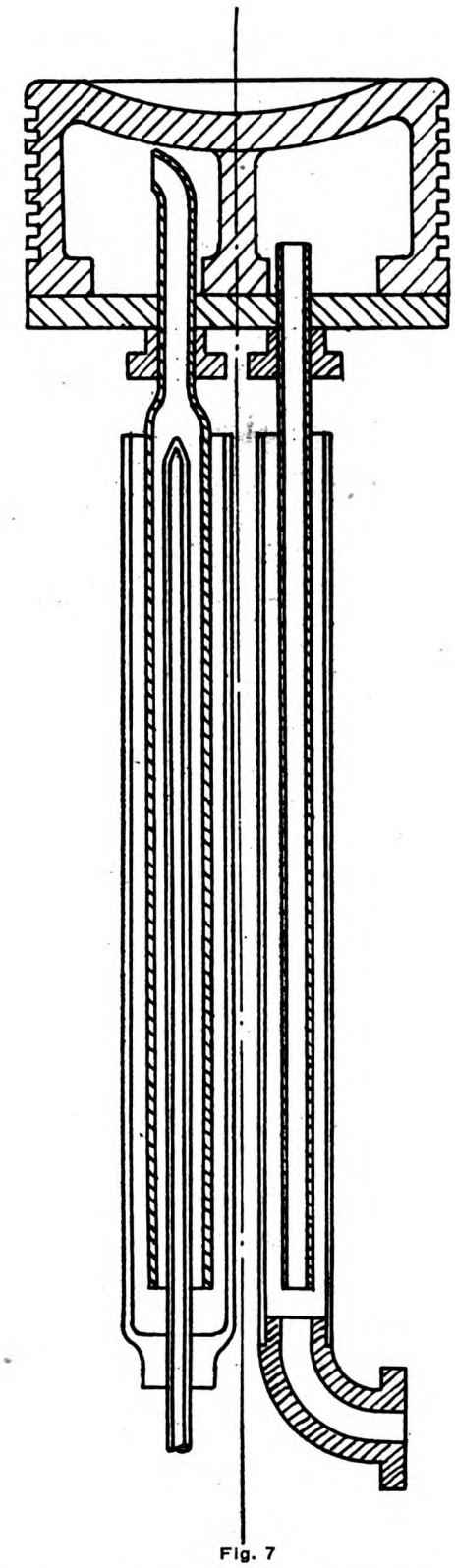

Fig. 7

shown in Fig. 7. This recently was dropped in favor of another design, although I understand several of their Licensees still stick to the arrangement shown in Fig. 7 in preference to the newer arrangement. The water enters by the central tube and flows into the tube attached to the piston, which directs the water to the piston crown. As there is no contact between these two tubes, exact alignment is again a matter of little importance; naturally there is a continuous spilling of water between these two tubes, which is collected by the large outside pipe whence it drains away. On the discharge side, only two pipes are fitted, the outside one being large enough to carry away the water without its overflowing.

It will be noted that the outlet tube projects nearly half way inside the piston, so that the piston can never be empty, the splashing of the water providing better circulation and so reducing the risk of local heating.

(*To be continued in our August issue*)

A GREAT ENGINEERING ADVANCE

Wm. Doxford & Sons, Sunderland, the British shipbuilders, are prepared to construct Diesel engines for merchant ships that develop 4,000 I.H.P. at 70 R.P.M. from four cylinders on a single propeller-shaft, or 1,000 I.H.P. per cylinder. As mentioned previously, the single-screw vessels now building at Doxford's yard will develop 3,000 I.H.P. from four cylinders.

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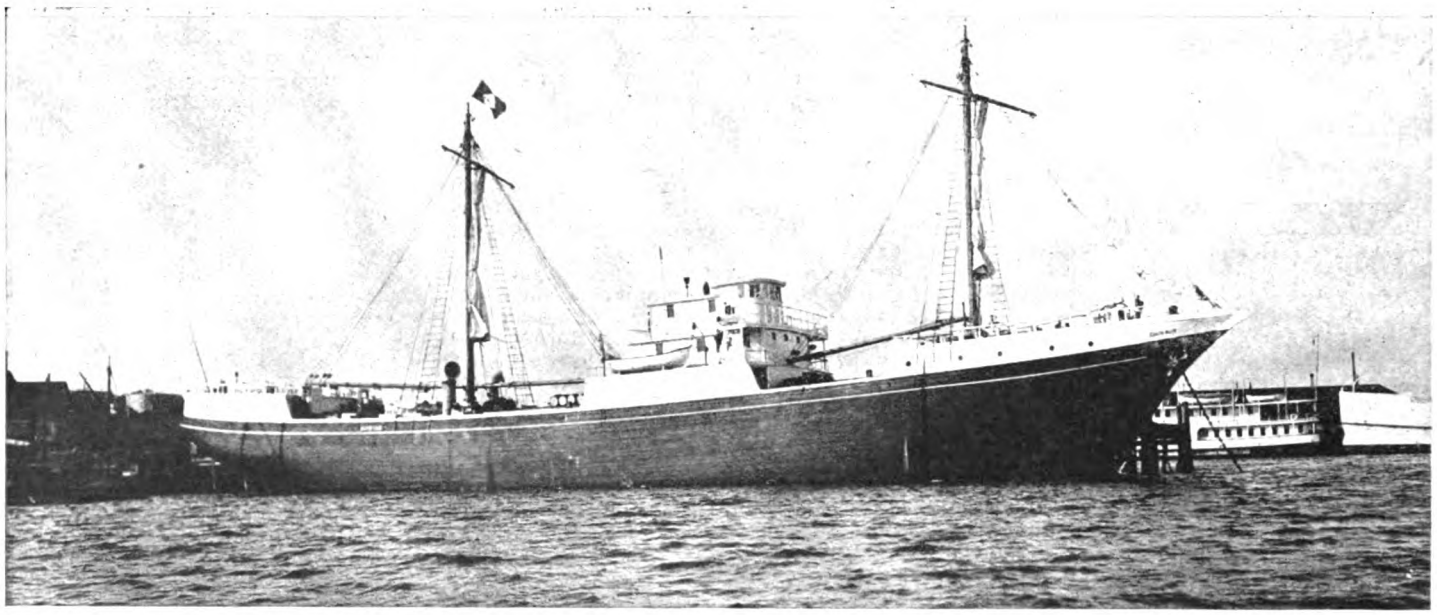


The American designed, built, engined, and owned, full-powered, twin-screw Diesel ship "Edith Nute," operated by the Atlantic Maritime Company of Boston, Mass. She was described on page 7 of the November 1917 number of "Motorship." She has a d.w.c. of 1,300 tons

American Motorship Enters Trans-Atlantic Trade

Results Attained by the Nelseco-Diesel Engined Wooden Freighter "Edith Nute"

IN the November 1917 issue of "Motorship" there was described a wooden vessel of 1,300 tons carrying capacity, building at the yard of L. L. Snow & Co., Rockland, Me. During construction she was changed from sail to motor power and equipped with two 240 H.P. Diesel engines of the high speed type, built by the New London Ship & Engine Co. of Groton, Conn. This vessel, the motorship "Edith Nute,' was built to the order of, and is operated by, the Atlantic Maritime Co. of Boston, Mass. and on her last voyage was under charter to the U. S. Shipping Board, to carry "barreled" oil from New York to Lisbon. The owners believe that the "Edith Nute" was one of the first, if not the first, full-powered American built and engined motorship to enter Trans-Atlantic trade. Let us impress upon our readers what that statement means! It means that American private owners have made a step in the right direction although far behind at present, as the European countries are already operating 8,000, 9,000, 10,000 and 12,000 tons steel motorships with speeds of 10 to 15 knots.

In order to make some reliable and interesting comparisons on the operation of the small motorship over the steam vessel of similar size, we paid a visit to the M.S. "Edith Nute" upon her arrival at the foot of East 8th Street, Manhattan, from Lisbon, Portugal, on June 7th last.

First and last we heartily endorse the opinion of her skipper Capt. Flynn, that a wooden-ship built for a Diesel motor, or any power, must be built right. The hull must stand the strain of being forced into a head wind at sea. The line shafting must run true and the boat not work and give as is permissible in a sailing-vessel. The engine-bed should be extremely solid and the thrust of the propeller well distributed to the hull through the foundations of the thrust-block.

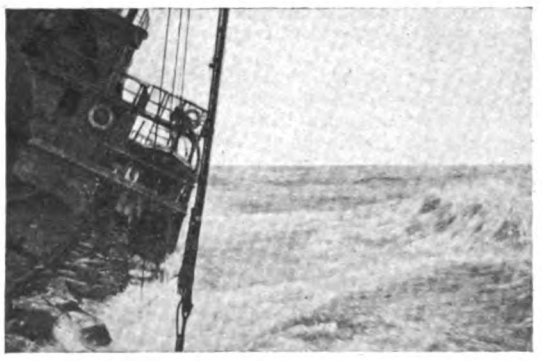
Capt. Flynn is satisfied with this ship and her engines. Several of the crew expressed themselves enthusiastically on the same subject and the accompanying photographs indicate they are in a position to know whereof they speak. The round voyage was made under exceptionally adverse weather conditions—the trip over being completed in twenty-one days and the trip back in twenty-four days. Going over, the vessel was forced off her course until she was way up along the coast of France within a day's run of entering the English Channel. During this passage it was said out of nine vessels that they sighted, seven of them asked if assistance was needed. Her schooner stern, clipper bow and short pole masts together with the absence of a smoke-stack gave the impression, from a distance in heavy weather, that she had suffered considerable punishment. Then again, due to her deck load of 360 bbls. of oil and six fuel tanks holding 30,000 gallons (750 barrels) of fuel-oil, located at the level of the upper deck she rolled very heavily.

Starting from the bow and going aft her top-sides consist of a foc'sle head,—then, between No. 1 and No. 2 hatch a deck house surmounted by a pilot house, Captain's quarters and a bridgedeck. In way of the deck house the ship's sides are continued above the bulwark to the height of the boat deck—about ten feet above the upper deck. The hatch coamings which are formed by two continuous fore and aft stringers above the upper deck are about thirty inches high at the sides. Between Nos. 2 and 3 hatch aft of the bridge erection amidships are the cargo winches, main mast, twin exhaust-pipes of about 8" dia. and companionway to an upper grating at the after end of the engine room. Proceeding aft to the poop-end bulkhead we come to the officers quarters and messroom.

As stated above the fuel and lubricating oil-tanks are located above the main deck—four of these are situated in the deck house amidships and two aft under the poop deck. Beside the 40,000 gals. of fuel oil there is capacity for about 2,100 gals. of lubricating oil. Figures and statements taken from the engine room log show the following facts:

Leaving New York harbor on April 4th the vessel logged 3,000 miles to Lisbon in twenty-one days, with but two stops for the port engine one of which lasted but 25 minutes to change the high-pressure suction-valve on the two stage compressors and which could and should have been done without shutting down the engine. The starboard engine was not stopped for any cause the whole trip. A direct voyage from New York to Lisbon, Portugal, at the ship's normal speed of 8½ to 9 knots could have been completed with favorable weather in eighteen days.

The total fuel-consumption for the round voyage amounted to 653.5 barrels in forty-five days running at sea with a lubricating oil consumption of 1,047 gals. (26.1 barrels) for the total trip. At the rated power these figures work out to 0.40 lbs. per B.H.P. hour for fuel, and 0.015 lbs. per B.H.P. hour for lubricating-oil. A paraffin-base Navy standard Diesel engine fuel oil was used taken on at the Standard Oil Company's docks at Bayonne, N. J. The cost was less than 7 cents a gallon—in fact the total fuel bill for the trip amounted to only $1,700.00 and the wages of the crew from April 4th to June 11th did not exceed $4,000.00. In this connection it may be said that with the exception of the Captain, the Chief-Engineer, and 1st Assistant, the entire personnel of the ship was new. As regards the engine-room staff it was surprising to learn that in addition to the 2nd and 3rd not having had actual experience with this particular design of engine before, there were no oilers shipped for the voyage. This means that there was only one man in the engine room at a time and to realize that these two engines were of the eight-cylinder high-speed-type each turning at 300 to 325 revolutions per minute. The continuous heavy variations in load due to the propeller running almost entirely out of water and then suddenly deeply submerged gives one an idea of the reliability obtainable in service. Nevertheless it is not good seagoing practice to go without an oiler on duty, besides the licensed engineer during each watch and we believe the "Edith Nute" will ship a full engine-room crew on her next voyage.



First Mate of the "Edith Nute" "shooting the sun" under difficulties

The many remarkable performances accredited to the Diesel-type of engine in cargo boats are due many believe, directly to the correct understanding of the particular design and the policy of close and correct attention to every detail concerning the engine room before starting out on a trip. Coming back from Lisbon only two stops were made on starboard-engine and one on the port until she stopped to take on the pilot at Sandy Hook. Here, when the port engine was reversed, the tail-shaft broke and the vessel entered the harbor driven by only one engine.

This matter was closely analized and explained to us as follows. When the vessel was built there was no provision made for lubricating the outer bearing of the tail shaft, which consisted of a brass sleeve shrunk on the 4" diameter propeller-shaft and running in a bronze bushing. With this condition of things existing—imagine what happened during the life of the shaft. It is safe to say the bearing heated up in no time and the brass-sleeve shrunk on the propeller-shaft froze in its bearings and if pinned to the shaft, which was not definitely known, sheared these and henceforth the steel shaft ran in its brass sleeve as a bearing and the wear and corrosion due to the action of heat and salt water must have been very rapid.

Although the shaft was originally one quarter inch oversize as far as strength requirements went, the additional friction would require an increase of shaft horse-power from the port engine to keep up the revolutions with that of the starboard propeller. After a year and a half of this state of affairs, concluding with excessive wear and shocks for 45 days in heavy weather, the engine was stopped and reversed on picking up the pilot as mentioned above. Naturally this final strain of reversal was "the straw that broke the camel's back."

After discharging her cargo of cork and hides

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the vessel will be dry-docked and it is expected that due to this oversight when building the ship the starboard shaft will also need renewal and a reliable lubricating device provided for each stern bearing. It is not known at the time of writing whether the port propeller has been lost or not. Such accidents as these often serve to cause astonishment and incidently appreciation of the supposedly ordinary good work of a piece of machinery which was thought to be working smoothly when in reality it had been delivering its power under the most severe handicap. It is the revelations of actual experiences that produce perfection in the hidden details and in this we must learn for ourselves.

Returning to the operation of the engines and the question of upkeep, 1st Asst. Engineer Jos. G. Carr stated that while in Lisbon two cylinder-heads were taken off and the piston-head and sides were found to be absolutely clean. This condition obtains after nearly two years of service—the piston rings being bright and clean and perfectly free. While at that port the repair work done ashore, according to Chief-Engineer W. J. Anderson, amounted to about $75.00 and was of a character that could have been done on the ship had even very limited facilities been provided. All valves were said to be examined about every thirty days running time and the exhaust valves ground, if necessary.

While the "Edith Nute" was at Lisbon, coal was $40.00 a ton and we cannot refrain from drawing a comparison. At $7.00 a ton on the Atlantic coast of the United States the average cost for coal would be $23.50 a ton. The fuel-oil burned in the Diesel motors cost $1,700.00 as previously stated and amounted to 26,140 gals. 93.35 tons; a cost per ton of $18.21. The fuel-consumption of a coal-burning steam-plant of the same low power would be 2.0 lbs. to the horse-power hour, and of the oil engine, 0.45 lbs. per h.p. hour. This gives a ratio of 4.4 to 1 as the relative consumptions of fuel by weight for an equal amount of propulsive horse-power. This then brings the cost of the steamship propulsion equivalent to that obtained from a ton of fuel-oil burned by the Diesel engine to $103.40 or a ratio of 5.6 to 1 in dollars and cents as the relative cost of ship propulsion of the two systems at these particular prices.

This incidentally gives an idea of the profit earning possibilities of extra large oil-bunkers on Diesel ships as a side issue. A sort of pin money as it were. For instance if the "Edith Nute" could have sold 10,000 gals. of fuel oil (35.7 tons) in Lisbon at about $50.00 a ton, (based on the price of $40 a ton for coal) her fuel-bill for the round trip would be on the other side of the account amounting to $85.00 profit! This sale of fuel-oil would be entirely feasible as she arrived in New York with 13,860 gallons (371 barrels) still in her tanks, or enough to take her back to Spain. Had she been a steel ship with double bottom, the figures would have been exceeded. In addition to this she carries several hundred tons more cargo than a coal-burning or oil-fired wooden steamship of her size.

M. S. "Edith Nute" in heavy weather
Note the exhaust pipes attached to the mainmast and the condition of the deck load

Mr. H. B. Nute, Pres. of the Atlantic Maritime Co., of Boston is well pleased with the economy of this little ship and expects to operate her in the Gulf Coast trade and to acquire additional motorships as circumstances permit. The auxiliaries on this vessel are as follows: One Fairbanks-Morse Y—15 H.P. stationary type for cargo handling at Nos. 2 and 3 hatch, which drives the winches by a chain through the main deck. This chain device is a very clumsy and in fact is a dangerous rig, for we are told that at one time when the chain broke it wiped down over the port-engine and broke one of the valves on a cylinder head. The winches up forward are powered in a similar manner by a stationary engine under the forecastle head. On the upper platform at the forward end of the engine-room where the first mentioned machine is located is found also a Fairbanks-Morse oil-engine driven electric generator for the ships lights. The particulars of the propellers may be of interest. They have four blades with a dia. of 5 ft. 4 in. by 3 ft. 5 in. pitch. The projected area is 15 sq. ft. and the r.p.m. 325. The slip is 33 per cent.

PERFORMANCE OF THE CANNERY TENDER, "ENOS"

Last spring a 22 h.p. Gulowsen-Grei heavy oil engine was installed in the cannery tender, "Enos," owned by the Pacific Mild Cure Co. of Seattle, Wash., and Port Conclusion, Alaska. This motor replaced a 27 h.p. gasolene engine.

Previous to the change, the "Enos" never made more than 6½ knots; but on tests with the new power plant she registered over 7 knots with the log, and on the way to Alaska from Ketchiken to Petersburg, a distance of 131 miles, she averaged over 8 knots, covering the distance in 15 hours and 40 minutes.

The boat is 44 ft. long on keel by 13½ ft. breadth, and is of 15 tons capacity. Chief Engineer F. H. Thomas of this little craft states that since the new engine has been installed, they have traveled about 1,000 miles without any trouble of any kind and that the engine is running better every day.

Cannery Tender "Enos" fitted with a 22 h.p. G. G. oil-engine

The motor workboat "KP," which is creating quite a little stir in the Maine fishing field. She is owned by Brawn Willard & Co. of Portland, Maine, and is fitted with a 30 H.P. G. G. single-cylinder oil-engine in conjunction with a reversing-propeller.

7,000 B.H.P. BRITISH DIESEL-DRIVEN SUBMARINE

It is reported that the British 1,100 tons submarine L-50, launched at the Fairfield Shipbuilding Co.'s yard at Govan, Scotland, is fitted with Diesel oil-engines aggregating 7,000 b.h.p.

THE ITALIAN NAVAL TANKS

Reference has been made to the Italian motor-driven naval "tanks." These are punt shaped craft fitted with two endless steel toothed chains running fore and aft round the hull. They were used for climbing Austrian harbor booms.

ANOTHER DUTCH AUXILIARY

A Kromhout oil-engine has been fitted in the new 950 tons auxiliary ship "Boven Karspel," owned by the N. V. S/V Mij Europa, and built by Wortelboer & Co. of Westerbrook.

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Machinery Arrangements and Details of a Veteran Swedish Motorship

Interesting Description of the Layout of Main Diesel Engines and Diesel-Electric Auxiliaries in the Engine-Room of the M. S. "Kronprins Gustav Adolph"

By R. D. KARR

IN completing five years and five months of service since January 1914, the Swedish motorship "Kronprins Gustav Adolph" of 6,550 tons d.w.c. also has just completed eleven months continous operation under charter to the Belgium Relief Commission. Since July 1918 she has made six round trips to America and returns to Antwerp, Belgium, carrying wheat and coal. The ports of call in the United States being Baltimore three times, Philadelphia once and New York twice.

This gives in round numbers 38,500 miles of sea travel at an average speed of about 10 knots with two 1,000 i.h.p. Burmeister and Wain, six-cylinder 4-cycle Diesel engines turning at 140 r.p.m. The bore and stroke of the working-cylinders being 540 mm x 730 mm (21.259 in. x 28.740), respectively.

From the total distance travelled and average speed we find she has been at sea at least 160 days out of the 330 days in the past eleven months. We have the Chief-Engineer's word for it that her operation has been without any but the minor repairs to be expected in service with any ship, and thus we realize the uniform regularity with which the vessel operated.

The owners of the "M. S. Kronprins Gustav Adolph"—the Rederiaktiebolaget Nordstjernan—whose representative in New York is Mr. G. Ekstrum at 135 Broadway, also own and operate a large fleet of noteworthy sister motorships and others still larger; a list of which includes the following additional 15 vessels:

Name	Dead Weight Capacity	Length	Breadth	Depth	Power	Make
M. S. "Suecia"	6,550 tons.	362′	51′-3″	25′6″	2,000 I.H.P.	B. & M.
M. S. "Pedro Christopherson"	6,550 tons.	362′	51′-3″	25′6″	2,000 I.H.P.	B. & M.
M. S. "Pacific"	6,550 tons.	362′	51′-3″	25′6″	2,000 I.H.P.	B. & M.
M. S. "Kronprinzessin Margareta"	6,650 tons.	362′	51′-3″	25′6″	2,000 I.H.P.	B. & M.
M. S. "San Francisco"	6,550 tons.	362′	51′-3″	25′6″	2,000 I.H.P.	B. & M.
M. S. "Valparaiso"	6,550 tons.	362′	51′-3″	25′6″	2,000 I.H.P.	B. & M.
M. S. "Lima"	6,500 tons.	362′	51′-3″	25′6″	2,000 I.H.P.	B. & M.
M. S. "Balboa"	9,200 d.w.	...	....	....	3,000 I.H.P.	B. & M.
In service since January 1919, One New Ship	9,200 d.w.	...	....	....	3,000 I.H.P.	B. & M.
Building for 1919 delivery, seven more ships	9,200 d.w.	...	....	....	3,000 I.H.P.	B. & M.
Total 15 ships	127,600 tons				37,000 I.H.P.	

All of the first seven vessels including the "Kronprins Gustav Adolph" have a speed of 10 knots turning their twin propellers normally at 140 R.P.M. These propellers we were told are 10 ft. 0 in. dia. by 8 ft. 2 in. pitch. We believe the latter figure must be an error for it gives an apparent slip of only 11.3 per cent. The fuel-consumption is approximately 7 to 7½ tons per day, and from the total volume of the fuel-tanks in the double bottoms of 1338 tons we figure her cruising radius to be 42,720 nautical-miles and in point of time, 178 days. These astonishing figures are derived from the capacities of the double bottom-tanks as shown in the table below. However, we doubt if she carries such a large quantity of fuel, but when possible uses the available extra carrying tonnage for cargo in her holds.

Frame No.	Tank No.	CAPACITY Oil		Water Ballast
0 to 12	After Peak	.....		52.5 tons
12 to 13	Well	.....		.....
13 to 46	No. 6	2 x 138	or	2 x 150
46 to 63	No. 5	2 x 61	or	2 x 66
63 to 93	No. 4	2 x 124	or	2 x 134.5
93 to 115	No. 3	2 x 91	or	2 x 99
115 to 137	No. 2	2 x 90	or	2 x 98
137 to 167	No. 1	2 x 165	or	2 x 182
167 - stem	Fore Peak	.....		73.5

1,338 tons oil or 1585 tons water

In tank No. 5 under the engine-room are two tanks, one to port and the other to starboard built into the fuel-oil space each of 5 tons capacity for lubricating oil.

The arrangement of holds and hatches throughout the ship is as follows:

Collision Bulkhead at Frame No. 167

Under Hatch No. 1	Hold No. 1	Frame 167–138
Under Hatch No. 2 & 3	Hold No. 2	Frame 138– 94
Under Hatch No. 4	Hold No. 3	Frame 94– 64
Under Skylight, Engine Room		Frame 64– 45
Under Hatch No. 5	Hold No. 4	Frame 45– 12

After peak bulkhead is at frame No. 12 up to the lower deck then above that at frame No. 11. The total net tonnage under the upper deck is about 3329.52 tons.

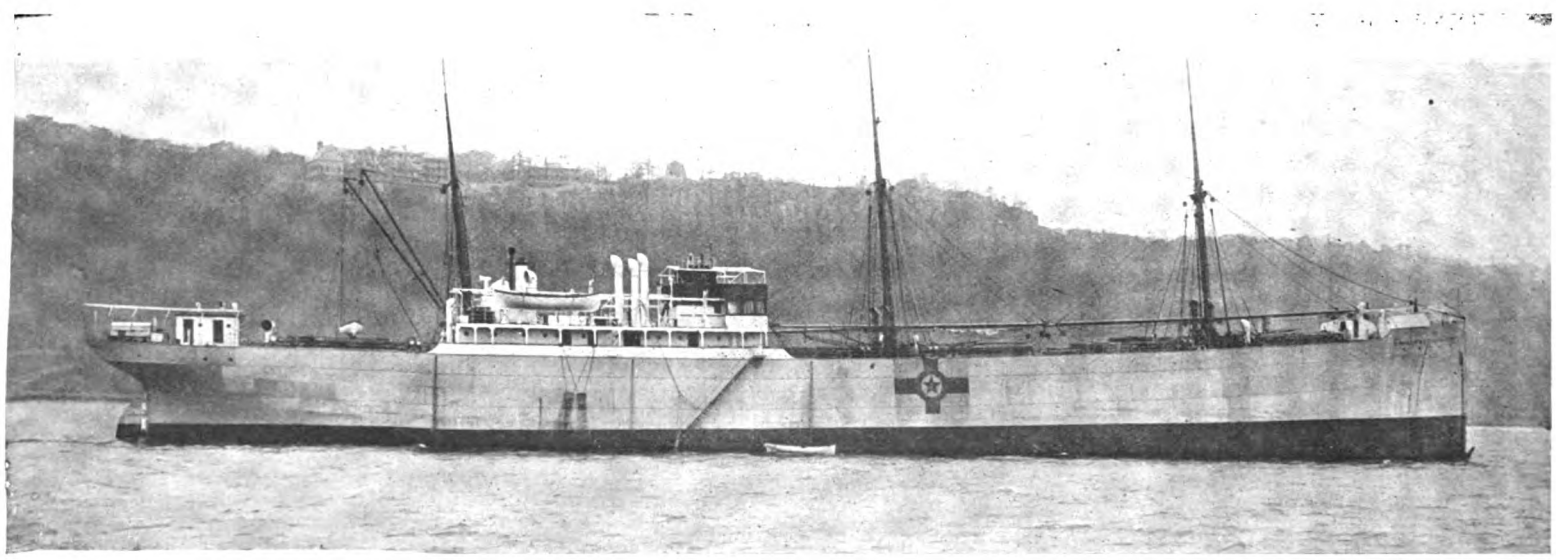
The general arrangement of the engine-room machinery is in four groups or rows running fore and aft. The spacious appearance and sense of roominess is added to by the orderly arrangement. This may be briefly described by saying—the two centre rows are formed by the two main engines and the two outboard rows by duplicate Diesel-engined direct-connected generator and auxiliary air-compressor all in a fore and aft line. Other machinery consisting of pumps are located aft of that.

On entering the upper engine-room on the level of the bridge-deck from the passageway between the engineers' staterooms, the engine-room casings are seen to be quite free from any machinery such as feed-water heaters, filters, evaporators, blowers, lighting sets, etc., usually seen with steam installations. Perhaps the most elevated piece of machinery in the ship is the one exception to that statement, this being the small radio motor-generator located at this level on the starboard engine-room casing. This machine takes current at 220 volts and 29.5 amps. and running at 1500 r.p.m. delivers 2½ K.W. of 500 alternations per min.

Descending to the upper gratings we land at the level of the cylinder heads, and at this height on the forward engine-room bulkhead are located the two day or settling-tanks for the fuel-oil each of 3½ tons capacity. There is provided the usual filling and overflow connections and a float gauge. Continuing below to the middle grating at the cam-shaft level we come to the auxiliary-machinery switchboard panel located forward under the day settling-tanks. This panel is of large size (about 8 feet wide) inasmuch as all auxiliaries including eleven cargo winches are motor driven. The current is supplied at 220 volts by either of two duplicate direct connected generators. In back of the switchboard are located in a generous space provided for them the starting boxes, fuse boxes and connections necessary in a duplicate installation. Over on the starboard side at the same level, and under the lower deck is the machine shop powered with an electric motor, belt-connected to a small lathe (about 50″ bed), a shaper and a drill-press. Thus with a bench and vises, accommodation is provided for performing repairs to any but the larger engine parts.

Continuing to the operating platform or engine-room floor level we find ourselves between the two main-engines at the engineer's log desk. The general scheme, as mentioned before, in the layout of machinery may now be followed in detail. The two main engines and thrust-blocks form the centre rows of machinery separated by the gratings etc. and about ten feet apart. Right at the floor level forward of the centre are duplicate motor-driven rotary fuel-oil pumps of ¾ H.P. These lift the oil from the double-bottom tank to the settling tanks above. Forward of these are duplicate sets of twin lubricating rotary-pumps, motor-driven,—one pump for the port and one for the starboard engine in each set. This installation is very simple and as a whole forms a rectangle with a small pump at each corner and about a 2 H.P. motor at the centre of each side. The armature shafts run fore and aft, and are connected at both ends by flexible couplings to the pumps. These, of course, are cross-connected, but ordinarily the forward pumps serve the port strainer and cooler situated on the engine-room forward bhd. and the after pumps serve the starboard strainer and cooler.

Returning to the engineer's desk we see the



The M.S. "Kronprins Gustav Adolph." One of a fleet of sixteen Swedish motorships of 6,550 tons d.w.c. and over aggregating 134,156 tons d.w.c.

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control station at the centre of each engine with the Chadburn engine-room telegraph within arm's reach of the fuel throttle.

The fuel-pumps are also located within direct supervision of the operators. At the after end of this central space are duplicate centrifugal circulating-water pumps arranged with the shafts vertical. The pumps are located below the floor plates and have a 5" suction. On the upper end of the vertical shaft is mounted an electric motor, taking 8.5 amperes at 220 volts and running at 1450 R.P.M. Mounted adjacent to each flywheel and readily placed in mesh with teeth on the forward edge of same is an electric motor with a vertical armature-shaft carrying a worm. The ease and speed with which this turning-engine will turn the large main motors was demonstrated to the writer and it was evident that an exact dead-centre or point of valve opening or closing could be obtained with absolutely no manual effort on the part of the crew. This should be an attractive feature when speed of repairs and checking of the valve-gear is required and, of course, it now is standard practice on all large motorships.

Each thrust block is made up of seven pieces of the usual horse-shoe type. A thrust-bearing of the Kingsbury or Mitchell type would be much more suitable for more modern motor vessels. Between the thrust-blocks is located a small upright boiler for heating purposes only. This outfit naturally is operated only a portion of the year and is perhaps, all things considered, an economical and generally reliable means for heating the living quarters throughout the ship.

Outboard of the main engines, which have an overall length of about 35 feet there is, starting from forward, the auxiliary four-cylinder four-cycle oil-engine, direct-connected to 220 volt alternating current generator. The engine develops 250 H.P. at 224 r.p.m. and just aft of the generators on each set is a vertical, tandem, single-crank, three-stage air-compressor, which delivers air at 25 Kg. per sq. cm. (355 lbs. per sq. in.). This may be disconnected at the coupling flange, when current from the generator only is required.

Aft of the compressor on the starboard side are the bilge and sanitary pumps driven by a 6 H.P. motor back-geared to a two throw crank-shaft driving trunk-piston plungers. On the port side is found a motor-driven set of duplicate ballast-pumps, with a six inch suction. The motor is of 18 H.P., using current at 220 volts, 70 amp. Outboard of the auxiliary engine on the port side is a rotary converter running at 1,400 r.p.m. to step down the current at 220 volts to 110 for lighting and the smaller motors.

A list of the electrical apparatus for the auxiliaries include the following:

11 cargo winches—12½ H.P. 220 volts.
1 ballast pump motor 18 H.P. 220 volts.
1 sanitary pump motor 6 H.P.
1 Bilge pump motor 6 H.P.
2 Lubricating-Oil pump motors.
2 Fuel-oil pump motors ¾ H.P.
2 Circl. water pump motors.
2 Turning-engine motors.
1 Radio motor generator.
1 Electric steering-gear motor.
1 Machine shop motor.

Practically all the electrical equipment was furnished by a Swedish firm, the Allmanna Svenska E/A., Västeras, Sweden, although some of the motors seem to have been delivered by the Asea E/A of Copenhagen, a subsidiary of the above concern.

Random Jottings

THE SHIPPING BOARD'S DIESEL ENGINES

Apparently the first American Diesel engines now running tests for the U. S. Shipping Board will not have the squarest possible deal, as we understand they will be installed in wooden hulls, which hardly will be a fair test of their ability. On the other hand, the Diesel engines now on order for the Shipping Board, in Copenhagen, will be installed in steel hulls.

The only consolation to be derived is that were it not for the wooden hulls, the orders for the American Diesel engines probably would have been cancelled, instead of a few being left on order. On this matter we probably will have more to say in a later issue, the news only having arrived as we close for press, and the situation is one that needs careful digestion before committing an opinion.

We understand that a Portland, Ore., firm—The Penninsula Ship Building Co.—is to equip two hulls now on its ways with two 750 b.h.p. McIntosh & Seymour engines. This decision followed the general cancellation of wood ship contracts on the North Pacific. The Penninsula Co. previous to the Government's entry into the ship-building programme, had built several boats of its own design, equipped with heavy-oil engines. These boats were the "Erris," "Esperance," "Pechiney" and "Adrien Badin."

While other yards centered their efforts on either the Ferris or Hough types, with one or two exceptions, the Penninsula yard built its own model, a large ship and one which has given excellent results in all tests. She is a type of vessel more graceful and of better proportions than some wood types, and has the additional advantage of offering better cargo space and arrangements.

When, therefore, the wood ship contracts generally were cancelled, the Penninsula Co. was able to convince the Emergency Fleet Corporation of the economy of putting oil-engines in these boats, and disposing of them as completed vessels rather than attempting their disposal as hulls or partially completed vessels.

This is the only instance in the United States where vessels originally intended as steamers were ordered converted and completed as motorships. The vessels are 287 feet long, overall. The extreme beam is 49.8 feet and the depth 27.6 feet. In steam service, these hulls are making their mark. The "Anoka," one of the Penninsula steam-driven hulls, is in the sugar trade between San Francisco and the islands, and is rated as one of the two best of the steam-driven wooden vessels in the trade. The "Adrien Baden," another of the first four full-Diesel powered ships, also is making her mark, as shown in the June issue of "Motorship."

GREAT DEVELOPMENTS PLANNED FOR THE BURNOIL ENGINE CO.

Extensive and important developments of the Burnoil Engine Co. of South Bend, Indiana, are now in course of being carried out. This company which builds the Brons type high-compression marine oil-engine has become associated with the Dodge Co. and the present plant is being moved to Mishawaka, Ind., where the new machine shop alone is 600 ft. long by 200 ft. wide. While the Dodge Co. will make castings and machine many parts of the Burnoil engines, the old Burnoil organization will continue as heretofore, with Mr. Carl Ross in charge of the business and Mr. B. T. Stanton as sales-manager. They are two gentlemen whom we hold in esteem by reason of our personal knowledge of them and their work. The Dodge Co. will assist in the sales of the engines which will be turned out in unusually large numbers in order to be always ready for prompt delivery.

MORE ITALIAN AUXILIARIES

Three 500 ton auxiliary wooden sailing-ships are under construction at Viareggio between the Burlamacca canal and the naval gun proving grounds of the Italian Royal Navy for the Societa Anonimi Costruzione e Navigazione Velieri. In these vessels Ansaldo San Giorgio Diesel-engines will be installed. All the engine-room and deck auxiliary equipment will be electric driven. The same yard is building a new type of motor propelled fishing-vessel, which is especially adapted for the Italian fishing trade. In these boats surface-ignition oil-engines will be installed.

THE CIRCULATION OF "MOTORSHIP"

An instance of how widely "Motorship" is circulated:—We have a son who already has a fine collection of foreign postage-stamps, everyone of which has been taken off letters received from readers of "Motorship" in various parts of the world up to several months ago. Thirty countries are represented in this collection; yet, until now the world had been in a state of war ever since "Motorship" has been issued. With the extraordinary postal mailing difficulties that have confronted our circulation department it is really remarkable that but extremely few copies have failed to reach their destination. Credit is due the post-offices of the various countries for so well distributing and delivering "Motorship." With the advent of peace we anticipate the circulation of "Motorship" soon will exceed that of any other domestic commercial shipping or marine engineering publication. This expectation is supported by the manner in which new subscriptions have come along since the Armistice, apart from the astounding steady demand for back numbers. We still need some copies of August, 1918. Have you any? We will pay fifty cents apiece for the first 25 copies to reach us!

"FREDA," A DANISH AUXILIARY SCHOONER

Another addition to the rapidly growing fleet of Scandinavian motor-driven auxiliary sailing-ships is to be found in the "Freda," a new 500 tons steel built vessel launched last April at the yard of the Korsor Shipbuilding Co., Svenborg, Denmark. She is the fourth of a number of standardized wooden craft of her design and size to be completed at this yard, one vessel being completed every three months, in addition to one motor tug-boat. Her deadweight-capacity is 500 tons, and she is propelled by a Tuxham surface-ignition heavy-oil engine of 150 b.h.p. The capital of the builders now is Kr. 1,000,000.00, but a few years ago the firm had but a small motor fishing-boat yard.

BRITISH ADMIRALTY SPECIAL SERVICE LAUNCHES

During the war a number of oil-engined Special Service Launches were built for the British Navy. Seventeen of these craft, namely the Z.1 to Z.17 were propelled by twin 180 b.h.p. Bolinder surface-ignition heavy-oil engines.

BUNKERING FACILITIES FOR DIESEL SHIPS

As the world fleet of motorships is fast becoming a prominent factor in the freight-carrying trades, the supply of suitable fuel at convenient points is important for both ships' operators and the various oil producing companies. An indication of the extent to which the oil companies are prepared to serve owners of motor vessels is indicated by the following list of its fuel stations on the seaboard of the United States that have been established by the Texas Company.

TEXACO FUEL OIL STATIONS

Location	Depth of Water
Providence, R. I.	25 ft.
New York, N. Y.	28 ft.
Philadelphia, Pa.	25 ft.
Baltimore, Md.	28 ft.
Norfolk Terminal, Va.	25 ft.
Charleston, S. C.	28 ft.
Savannah Terminal, Ga.	27 ft.
Jacksonville Terminal, Fla.	22 ft.
Tampa, Fla.	21 ft.
Pensacola, Fla.	Building
Mobile, Ala.	Building
New Orleans, La.	30 ft.
Port Arthur, Tex.	26 ft.
Galveston, Tex.	26 ft.
Port Aransas Terminal, Tex.	23 ft.
Cristobal, Canal Zone	On French Canal

At all of the above stations, lubricating-oils may also be obtained and vessels served by lighters at ship's side if necessary. The specifications of Diesel engine fuel-oil carried, meets the British Admiralty requirements for this type of machinery and are as follows:

Gravity	23 to 25 Baume
Specific gravity	0.917 to 0.905
Flash point—closed cup	200° F. min.
Viscosity, Saybold at	70° F. 650 sec. max.
Sulphur content	½% max.

On another page is given a map of the world showing many of the leading seaport oil stations, also the distances between principal ports.

COMPARATIVE COST OF OPERATING DIESEL-ENGINED AND OTHER SHIPS

The Scott Ship Agency Company, Inc., of 29 Broadway, New York City, act as agents for a French Government Line, which owns two sisterships, the "Alabama" and the "Oakwood;" the former being equipped with McIntosh & Seymour Diesel engines and the latter with triple-expansion steam-engines. A naval architect has furnished the following data, which is interesting because the boats are in the same service over the same routes:

"ALABAMA"
(Motorship)

Number of men in crew	24 and captain
Wages of crew	$2,565.00 per month
Wages of captain	$400.00
Deadweight tons carried	3,989
Cash disbursements at Honolulu for fuel and supplies for remainder of trip; both trips over same measured course	$2,600.00

"OAKWOOD"
(Steamship)

Number of men in crew	38 and captain
Wages of crew	$3,950.00 per month
Wages of captain	$350.00
Deadweight tons carried	3,600
Cash disbursements at Honolulu for fuel and supplies for remainder of trip; both trips over same measured course	$14,000.00

[The extra earning capacity derived from the additional 389 tons of cargo is not included, but at $30.00 per ton would be $11,670.00.—*Editor.*]

Another very interesting fact is that although the "Alabama" touched in at Yokohama, which the "Oakwood" did not do, the "Alabama" was a month ahead of the "Oakwood" when she reached Singapore. Both engines are of the same power, and the ships in all respects are practically duplicates.

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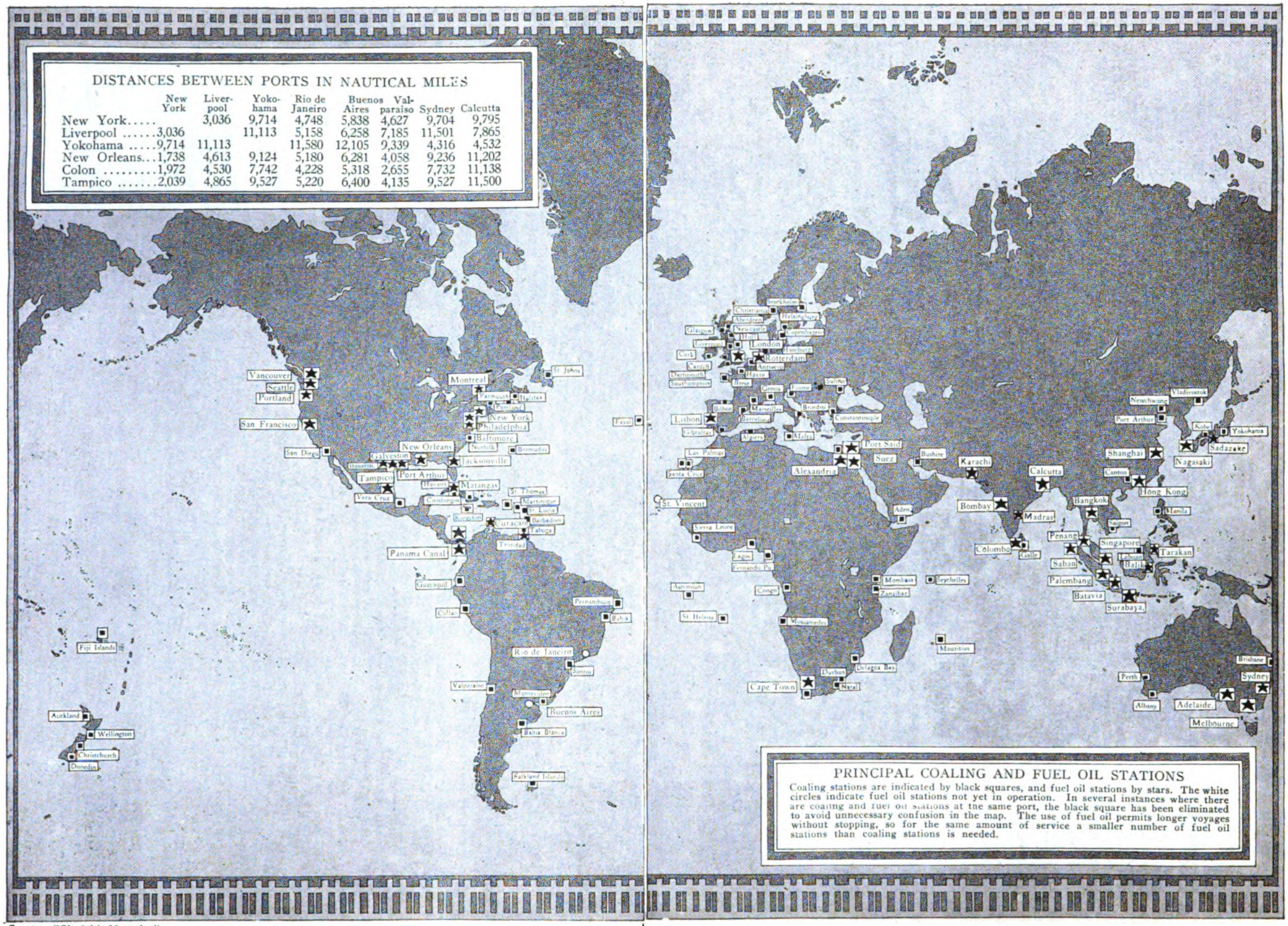
DISTANCES BETWEEN PORTS IN NAUTICAL MILES
PRINCIPAL COALING AND FUEL OIL STATIONS
Coaling stations are indicated by black squares, and fuel oil stations by stars. The white circles indicate fuel oil stations not yet in operation. In several instances where there are coaling and fuel oil stations at the same port, the black square has been eliminated to avoid unnecessary confusion in the map. The use of fuel oil permits longer voyages without stopping, so for the same amount of service a smaller number of fuel oil stations than coaling stations is needed.

	New York	Liverpool	Yokohama	Rio de Janeiro	Buenos Aires	Valparaiso	Sydney	Calcutta
New York.....		3,036	9,714	4,748	5,838	4,627	9,704	9,795
Liverpool 3,036			11,113	5,158	6,258	7,185	11,501	7,865
Yokohama 9,714		11,113		11,580	12,105	9,339	4,316	4,532
New Orleans...1,738		4,613	9,124	5,180	6,281	4,058	9,236	11,202
Colon 1,972		4,530	7,742	4,228	5,318	2,655	7,732	11,138
Tampico 2,039		4,865	9,527	5,220	6,400	4,135	9,527	11,500

Courtesy "Sinclair's Magazine"

WHERE BUNKER-OIL CAN BE OBTAINED

MOTORSHIP OWNERS DOUBTLESS WILL FIND THE ABOVE CHART USEFUL, AS IT SHOWS SOME OF THE PORTS WHERE FUEL OIL IS KEPT IN STOCK

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Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed.)

DIESEL ENGINES OF THE U. S. NAVY

To the Editor of "Motorship,"
Sir:

It gives me great pleasure to acknowledge the debt which the U. S. Navy owes to the builders of the Diesel engine for Submarines. The results are very gratifying and I am assured by the Commander-in-Chief of the Atlantic Fleet that during last winter's exercises the Submarines responded to every call.

That there is a great future for the Diesel engine is universally recognized and I feel confident that American manufacturers will not lag in taking advantage of its possibilities.

Yours very truly,
Franklin Roosevelt,
Assistant-Secretary of the Navy.

Navy Department,
Washington, D. C.
June 3, 1919.

WHAT AN U. S. NAVY OFFICIAL THINKS

To the Editor of "Motorship,"
Sir:

I have to inform you that I read your publication regularly, it being one of those subscribed for by the Bureau. It is needless for me to say that your efforts in developing the American Diesel Engine and bringing this subject home to the people of the United States is most commendable, and I congratulate you on the results of your efforts in this connection.

Very truly your.
J. O. FISHER,
(Commander, U. S. N.)

U. S. Navy Department,
Bureau of Steam Engineering,
Washington, D. C.

AMERICAN DIESEL ENGINES GAVE GOOD SERIVCE IN WAR ZONE

To the Editor of "Motorship."
Sir:

I have been reading your magazine "Motorship" with the greatest interest. It is exactly what I want. I graduated from the United States Naval Academy in 1916 and for the past two years have been doing duty on submarines, part of the time in the war zone off the south coast of Ireland, in which I saw the American Diesel engine operating successfully under the most arduous conditions. I then made a 5,000 mile trip back to the United States on the same submarine (A-L 10), half of the trip in the capacity of Commanding Officer.

Yours very truly,
Newbold T. Lawrence, Jr.
Lieutenant,
U. S. Navy.

U. S. R-16,
c/o Postmaster,
San Francisco, Calif.

AMERICA'S LEADING ARCHITECT AND THE MOTORSHIP QUESTION

To the Editor of "Motorship,"
Sir:

It seems to me the main thing we should all be keenly interested in at this time is, whether the United States is going to be a maritime nation. That is, are we going to be a ship owning and operating country, underwriting and cover the entire question. If so, there is not the slightest question about the Diesel engine coming into prominence and establishing itself as an important factor with us for ship propulsion.

Today, if I may say so, I am probably working as hard as any one man to bring this about It is a matter that cannot be played with and has to be carried along on pretty sound footing. I have little doubt but that within a reasonable short time there will be installations made—and properly made—representing American ingenuity of marine oil-engines that will be an important factor, putting the motorship on the map as far as the United States is concerned.

This will be done outside of the Government—that is by private owners, provided we are going to have some Government legislation to make a merchant marine for the operating of ships under the American flag possible.

Yours very truly,
Theodore E. Ferris

30 Church St., N. Y.

STANDARD WORK OF REFERENCE

To the Editor of "Motorship,"
Sir:

We have subscribed for many years for your journal the "Motorship," and as the same contains several articles of the greatest interest for us we have had every annual set bound.

Thanking you in advance we are, dear sirs,

Very truly yours,
LYSEKILS MEK VERKSTADS AKTIEBOLAG.

Lysekil, Sweden.

[We note that the majority of readers of "Motorship' have their copies bound as they find this journal a remarkable work of reference.—Editor.]

SOLID-INJECTION VERSUS AIR-INJECTION

To the Editor of "Motorship,"
Sir:—

Referring in general to your exceedingly interesting articles, published under the title of "Solid-injection versus Air-injection" and in particular to the comparison, between the two systems, on page 36, of the April number, where one reads as follows:—

> There are three outstanding points in which the solid-injection compares unfavorably with the air-injection system viz:—
> (1) High fuel-consumption.
> (2) Lower thermal-efficiancy.
> (3) Higher working-pressures.

—then the article proceeds to point out that the fuel-consumption of an engine working with air-injection is about 0.41 lbs per b.h.p. hour, whereas in the solid-injection case 0.44 to 0.46 lbs per b.h.p. hour, is stated to be the quantity required.

I would like to point out that the figures quoted as consumptions of engines using solid-injection, are no longer accurate for modern types, and probably refer to results obtained with engines built 3 or more years ago; however, since that time great improvements have been effected; and on looking over the official test sheets (taken at random) of twenty-nine (29) engines recently built, I find that the mean-consumption of this batch amounts to 0.40 lbs per b.h.p. hour, and the consumption on one engine was 0.381 lbs b.h.p. hour, throughout the run.

The official tests referred to are the six hour trials, carried out with the engines developing their full rated power (1,200 b.h.p.) when bolted down on the testplate; the power being absorbed by a Froude water-brake, and the fuel carefully measured in calibrated tanks, to the satisfaction, and in the presence of the user's representative; **I may add that the lowest figure mentioned, viz:—0.381 lbs per b.h.p. hour, has frequently been beaten on other engines tests.** This being so, it becomes quite evident that the disadvantages (mentioned under the three headings above) when comparing solid-injection with air-injection are non-existent in modern engines, and it is equally certain that as good if not better results can be obtained from engines fitted with solid-injection as air-injection, and these advantages can be obtained, without the complication and other disadvantages which are inseparable from the latter system.

Yours very truly,
British Subscriber.

London. W.

WHY NOT RECIPROCAL ENGINE TRADE?

To the Editor of "Motorship"
Sir:

There is in British Engineering circles a considerable amount of apprehension felt with regard to the danger of our markets being flooded with American oil-engine and other manufacture before we are ready to deal with the situation. American commercial representatives have been very busy since the Armistice booking orders over here, and, in the involved condition of English works, which I imagine is less serious than on your side, there has been some amount of alarm created as to the future. However, we are hopeful that in due course things will settle down; but, I must say that manufacturers over here would very much appreciate a little more reciprocation from your side in opening your markets to us in the same way as we do to you.

Yours very truly,
Oil-Engine Builder.

London, England.

PROPOSAL FOR NEW OIL-ENGINE OF THE TWO-CYCLE TYPE

To the Editor of "Motorship",
Sir:—

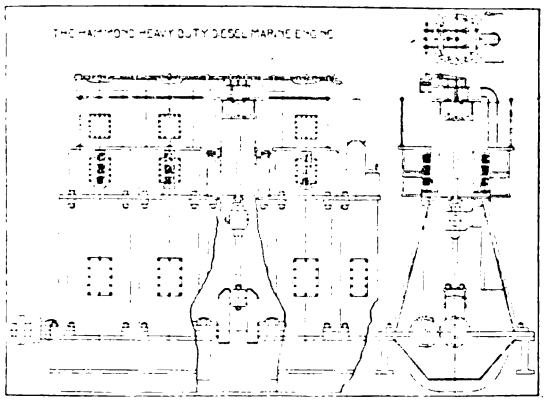
Some of us are inclined to scoff at theory; but, every machine, every work that has ever been undertaken since human effort has been exerted, has first been built on theory; every successful device that has ever been built by man, was first built by him in his brain, and then put on paper so that the proportions and weights, strength etc., could be proportioned in a perfect mechanical efficiency.

I have worked-out in theory a perfected two-cycle engine, designed to give maximum, or up to 90% efficiency, and that is highest possible efficiency that any single-acting engine will ever be able to show. To do this I have, to describe a vertical engine, closed in the bottom of the cylinder that I may get a low compression on the intake air, which in turn is designed to force the burned-gases out of the cylinder. Having arranged a bypass by which the air compressed to about thirty pounds per sq. in. is allowed to pass above the piston, when on bottom center which gives an absolute expelling force to the fresh air that is to refill the cylinder for the next explosion, and as the exhaust-valves are in the head, the burnt gases must perforce and by force, be expelled.

This engine will have a piston bolted onto a flanged piston-rod in a way that the piston may be taken out without disconnecting the rod either at the cross head or the crank, and this making for ease and simplicity, as the rings of the piston must be examined very frequently this arrangement will eliminate much work and save time.

While I have eliminated half of the valves required in a four-cycle engine, I have in order that the valves may give the minimum amount of trouble, designed a self grinding device, attached to each valve.

A cylinder-oil lubricating device, entirely new in principal and one that will graduate and distribute to the part of the piston and cylinder that is doing the most work and demands the most oil, at exactly the right time and in proportion to the need. Also a piston cooling device that will fill every requirement, as it has the advantage of being designed to use any element whether oil, water or air, and having a positive pump action in itself so that the action is positive.



The feature of this engine is the combination oil and water fuel-spray valve, and a solid fuel-injection valve, both unique in their purpose and design. One is to be used in connection with the air-compressor which forces a charge of oil into the cylinder followed immediately with a small shot of water. As soon as the engine is under full way and is to run so, this valve is automatically shut-off and the engine continues to run with the solid fuel-injection valve thus relieving the engine of the 10% to 14% load of the compressor, which is also automatically thrown-out of gear as the valves change from one to the other. All claims in a series of patents have been allowed covering all of the special features of this engine.

There are also other advantages over the former two-cycle, in as much as the low compression of the air at the bottom has thereby raised its temperature, which in turn serves to raise the temperature of the lower end of the cylinder thus keeping the whole a more uniform heat, tending to eliminate the heat fluctuation, the cause of influences on metal.

In this I wish to point out that it is not the heat of the cylinder that causes the difficulties in metal, with the internal-combustion engine, but the great fluctuation of heat brought about by the intermittant fire and cold air, with oue end of the cylinder comparitively cool while the other end is intensely hot, and against that hot end comes the intermittant cold bath of air. It is this cause and effect that in my opinion makes the two-cycle engine preferable to the four, for the two has quicker explosions by one half and thus keeps the heat more normal, while in the four the lapse of time between explosions, by intermittant fire causes the temperature to vary to such an extent that the entire top of the engine is, and has been in doubt, as to stresses in large units.

There has been much, and will be more written on the subejct of the two cycle vs. the four, but as theory is always correct when mechanical device is right, my engine will dispell all arguments as to the possibility of expelling the burnt gases and the supplying of sufficient pure air to fire the charge, and as theory is fairly good system to follow, it will be shown in the very near future, how well theory will work in my new two-cycle Diesel engine.

Yours very truly,
F. S. HAMMOND,
Lieut. U. S. N., R. F.

New York, N. Y.

[There are many theories put forward by Lieut. Hammond which hardly agree with our own experiences.—**Editor.**]

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"Motorship" Illustrated Patent Record*

Selected Abstracts of Recent Published Patents of Internal Combustion Engines

Copies of original specifications may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

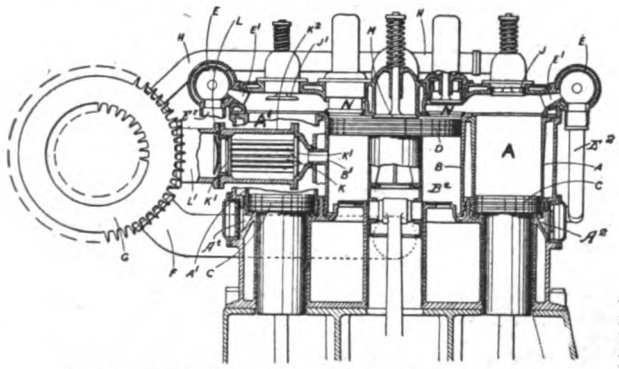
*Compiled and described by H. Schreck, Memb. Amer. Soc. Mech. Eng'rs

1,296,556. Mar. 4, 1919. Internal Combustion Engine. H. R. Ricardo, of London, England.

This invention relates to internal combustion engines, more especially to those of the compound type, and has for its object to dilute the charge of the high pressure cylinders with an inert gas with a view to economy.

The illustration shows the invention applied to a compound engine. A and A¹ are the high pressure cylinders which are working on the four-cycle principle. The lower ring space of these two cylinders is used to precompress the combustible mixture which passes through conduit E² and passage E¹ into the the cylinder A or A¹. B is the low pressure cylinder which works on the two-cycle principle and is supplied with the products of combustion through the valves N from the cylinder A or A¹ alternately. The lower ring face of the low pressure piston D compresses air or weak misture which is delivered through pipe F to a chamber G which is a cooler at the same time. The compressed air after being cooled passes to the valves J and J¹ thus serving to supercharge the cylinders A and A¹.

FIG. 1.

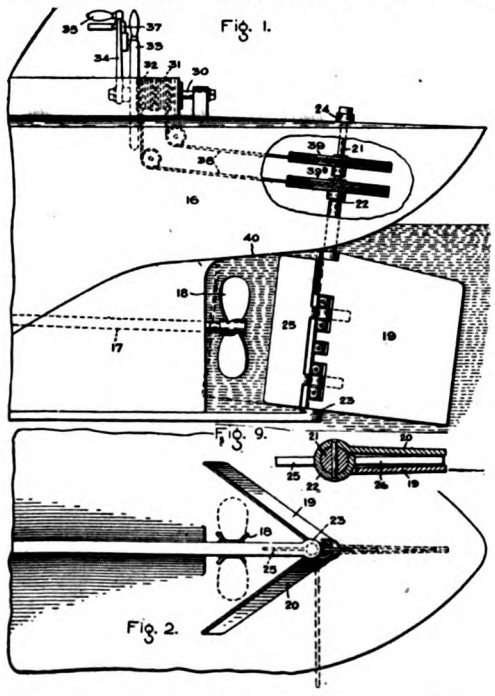


The low pressure piston will uncover when it has performed from half to two-thirds of its outstroke the port B¹ and let the burnt gases escape through the cooler K and the non-return valve L into the chamber G and mingle there with the fresh air. The remainder of the exhaust gases is permitted toward the end of the outstroke to escape through the exhaust valve M.

In connection with the above description it may be recalled that the idea of a compound internal combustion engine has been tried out from time to time for about the last 10 years by various engineers and at the present time again such an engine is being tried out on the test stand by the inventor E. A. Sperry, whose engine is covered by patent No. 1,226,132.

1,257,165 & 1,257,298. Febr. 19, 1918. Means for Controlling and Reversing of Vessels. H. O. Westendarp, of Saugus, Mass. Assignor to the G. E. Co.

The object of this invention is to provide means for controlling and reversing a vessel without reversing the rotation of the propeller. A divided rudded comprises two plates which are hinged together and which partly enclose the propeller. By suitable mechanism these two plates are made to turn together in the same direction or in equally opposite directions. For ordinary direct speed ahead the rudders will be fully

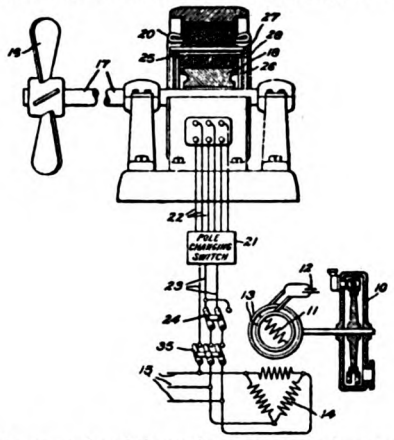


opened as illustrated in Figs. 1 & 9, and the two blades will then serve as a rudder only. When the blades are turned forward, as shown in Fig. 2 the reaction on the rudder blades causes the vessel to go astern. Various intermediate positions can be given to the rudder which will serve for steering or producing various speeds of the vessel.

A like invention has been patented in England under the name of Kitchen and is covered by the patent 3249-1914.

1,290,945 and 946. Jan. 14, 1919. Electric Ship Propulsion. W. L. R. Emmet, of Schenectady, N. Y. Assignor to General Electric Co., a Corporation of N. Y.

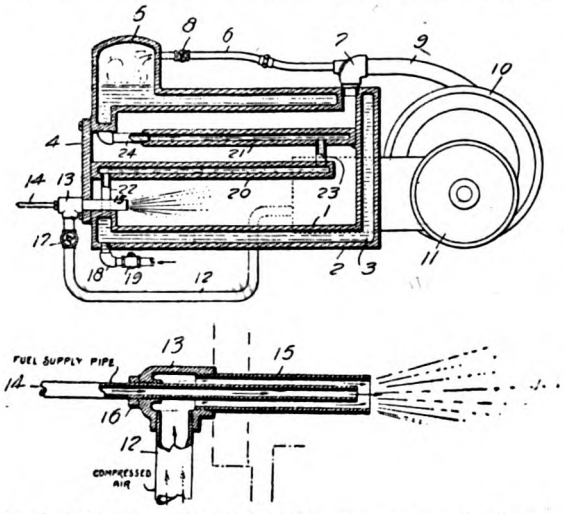
This invention relates to electric ship propulsion and in particular to the propulsion of ships by alternating current induction motors. The object of this invention is an improved arrangement of an apparatus for operating ships with a minimum of apparatus. This system comprises a single induction motor, which is direct connected to the propeller. This motor has a primary winding adopted to produce primary magnetic fields of two different pole numbers, and a secondary winding having a portion arranged to be inactive for the high pole number. The method of operating this system consists in connecting the primary winding for its high speed pole number for running the ship at full speed and for its low pole number for reversing and manoevring the ship.



It will be remembered that pole changing has been used before to obtain different speeds of an induction motor, but this is the first suggestion to employ pole-changing in a system of ship propulsion for the purpose of obtaining an increased motor torque for reversing the direction of motion of a ship. The torque of an induction motor, for a given generator output, increases when increasing the number of primary poles because the motor speed is thereby decreased, and that is exactly what is required for putting a ship into motion; slow speed of the propeller at a greatest possible torque. In this case the generator and motor act as a speed reducing mechanism between the prime mover and the propeller shaft.

1,294,120. Feb. 11, 1919. Internal-Combustion Turbine. C. E. Lang, of Livengood, Territory of Alaska.

This invention refers to a special construction of an internal combustion turbine. In a separate casing a combustion chamber is provided in which a steady high pressure is maintained during the working of the turbine. An air compressor 11 is arranged to supply the air which is to spray the fuel through the spraying tube 15 into the combustion chamber. The fuel itself is supplied at 14. The heat which is radiated in the combustion chamber is



heating the water in the jacket and the steam generated will enter the turbine 10 at 9 together with the gases of combustion and operate same.

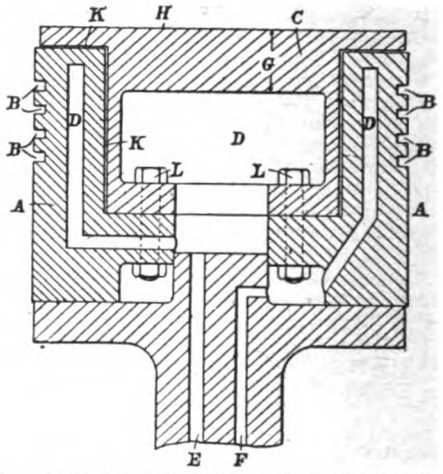
A modification of this arrangement will be to circulate in said jacket instead of water the compressed air before it is supplied to the spraying tube.

124,534. March 18, 1918. Piston. R. P. Doxford & K. O. Keller, Pallion Yard, Sunderland (British Patent).

This invention refers to the construction of a piston whose object is to reduce the compression of a cylinder working on the Diesel principle and to ensure initial ignition at such reduced compression pressure.

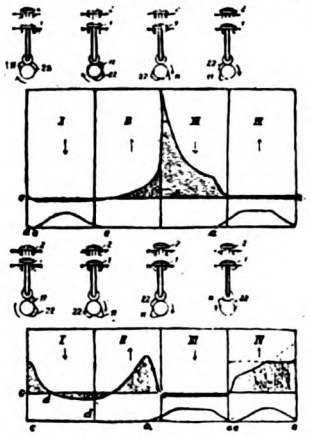
An end disc or plug C made of a material different from that of which the piston is made is attached to the piston, this connection as well as the piston is properly watercooled but the wall thickness G of the plug C is kept large enough so that the face H may become and remain incandescent. With this arrangement the same temperature has been reached as in the Diesel cycle at a compression pressure of about 320 lb. Another advantage of this construction is the lessened amount of cooling required for the piston, owing to it being designed so as to maintain a higher mean temperature than has heretofore been used. Less heat is being carried away through the piston to the cylinder walls, which fact will increase the thermal efficiency of the engine.

Remark: The writer believes that the inventor will have to use on his engine some kind of ignition plug in order to start his engine, which, of course, will not minimize the value of this invention.



28,661. March 18, 1918. Brake Arrangement for Reversing of Engines. A. Lahn, of Christiania, Norway. Assignor to A. Saurer Co. of Arbon, Switzerland. (Danish Patent, Class 46 b).

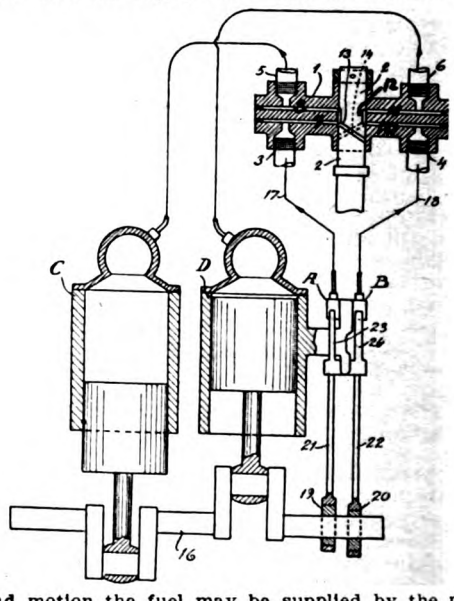
This invention refers to a gearing of the valves which purposes to bring a four-cycle engine quickly to a standstill, such as is desirable for the reversing or stopping of marine engines. This is attained by keeping the exhaust valve closed, by changing the timing of the cams in relation to the crankshaft



and by opening the suction valve a second time shortly before the end of the compression stroke which will let the compressed air escape instead of giving work back to the crankshaft. The effect of this gearing can best be seen on the accompanying diagram.

1,293,564. Febr. 4, 1919. Reversing of Internal Combustion Engines. K. F. Sjöman, of Stockholm, Sweden.

This invention refers to a novel arrangement of reversing an engine on which the fuel injection is controlled by the fuel pump. The inventor reverses the engine by pumping the fuel into certain cylinders when running ahead and the same pumps feed other cylinders when running astern and so simply the timing of the fuel injection is being changed. A small valve arrangement 1 is interposed in the fuel oil supply line. Say for instance, for



ahead motion the fuel may be supplied by the pump B through the ports 10, 12 and 11 to the cylinder D, whereas for the astern motion the stem 2 will be raised and the fuel will then be forced by the same pump through the ports 10, the inclined hole 14 to the port 8, and thence to the cylinder C.

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